FIELD COLUMBIAN MUSEUM

PUBLICATION 3.

GEOLOGICAL SERIES. VOL. I. NO. I.

HANDBOOK AND CATALOGUE

OF THE

METEORITE COLLECTION.

BY

OLIVER C. FARRINGTON, PH. D.,

Curator, Department of Geology.

CHICAGO, U. S. A.

August 1895.

PUBLICATIONS

OF THE

FIELD COLUMBIAN MUSEUM

GEOLOGICAL SERIES

VOLUME I.

CHICAGO, U. S. A.
1895–1902

TABLE OF CONTENTS.

Field Columbian Museum

Publication 3.

Geological Series Vol. I. No. I.

HANDBOOK AND CATALOGUE

OF THE

METEORITE COLLECTION.

BY

Oliver C. Farrington, Ph. D.,

Curator, Department of Geology.

Chicago, U. S. A.

August 1895.

PREFACE.

The care with which meteorites are treasured and the value they have assumed in the hands of collectors renders it desirable that as full information as possible should be available regarding the whereabouts of each specimen. To furnish this information in regard to the collection of meteorites of the Field Columbian Museum has been the principal object in issuing this publication.

It is also hoped, however, that a more thorough study of the collection will be facilitated by the Catalogue and that that portion of the work called the Handbook, when used in connection with the specimens, will enable any one not previously acquainted with the subject to gain some knowledge of the principal characters of meteorites.

Many of the statements of this portion of the work, for which it has not been practicable to give specific credit, have been drawn from authors whose works are mentioned at the end of the Handbook.

Prof. L. Fletcher's work, *An Introduction to the Study of Meteorites, edition of 1890,* has been found especially helpful and its plan of arrangement is so excellent that it has been largely followed by the author.

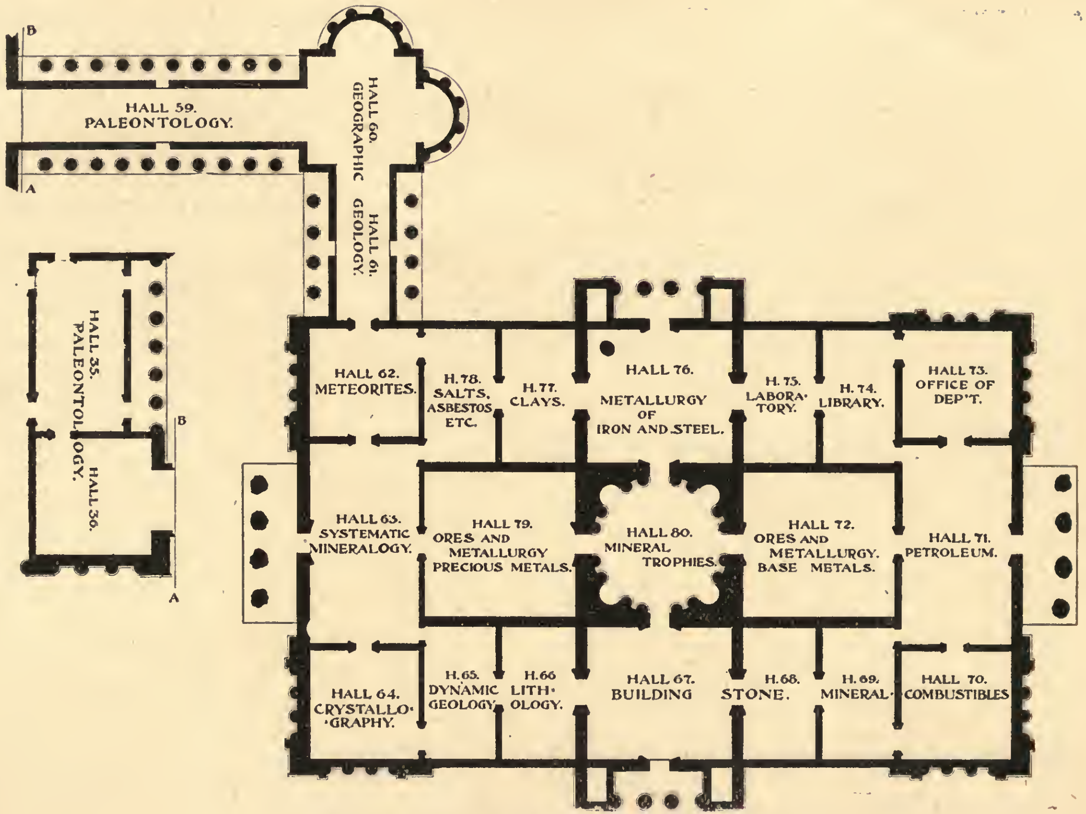
In the difficult matter of names of meteorites and the dates of their fall or find, the data given in Huntington's catalogue have, in the main, been accepted as correct.

No attempt at a plan of elaborate classification has been made, as none of the present systems seem to have gained sufficient acceptance to make them authoritative.

The divisions proposed by Maskelyne however, of *äerosiderites, äerosiderolites* and *äerotites* have been found to form so convenient a grouping that they have been followed throughout.

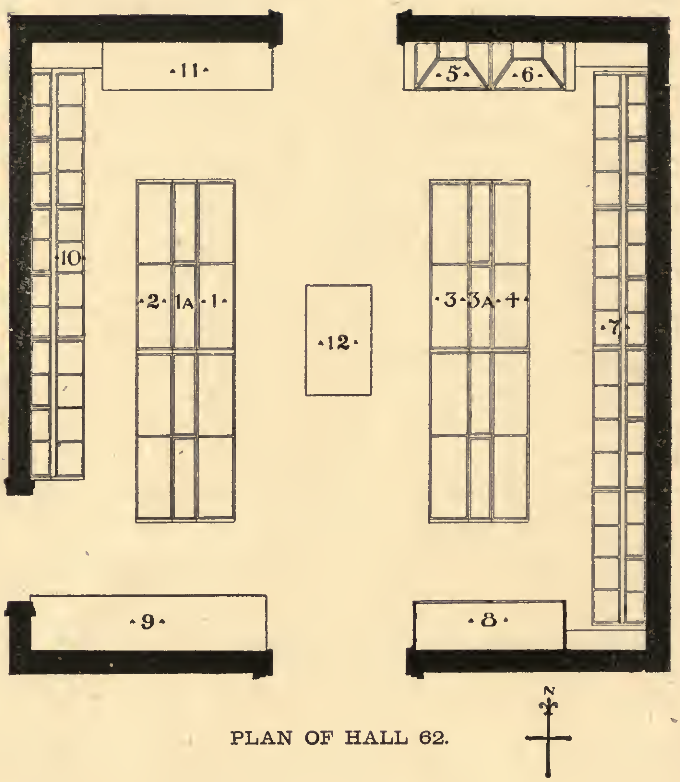
Grateful acknowledgments are due Dr. C. F. Millspaugh of this Museum for the generous aid he has given in preparing the photographs for the illustrations of the work, also to Prof. H. A. Newton and Dr. O. W. Huntington for information kindly furnished.

July 15, 1895. Oliver C. Farrington.



PLAN OF THE DEPARTMENT OF GEOLOGY.
Showing relation of Meteorite to other collections.

TABLE OF CONTENTS.



PLAN OF HALL 62.

ARRANGEMENT OF THE COLLECTION.

The collection of meteorites occupies Hall 62 of the West Annex of the Museum. The number and disposition of the cases in the hall is shown by the accompanying plan. The smaller specimens are arranged in the chronological order of their fall or find, in Cases 1-4 inclusive.

They are grouped for convenience, as shown in the Catalogue, into the three classes of *äerosiderites*, (meteoric irons) *äerosiderolites*, (meteoric iron-stones) and *äerolites* (meteoric stones.) The äerosiderites occupy Cases 1 and 2, the äerosiderolites part of Case 3, and the äerolites, the remainder of Case 3 and Case 4.

The place of fall or find of each specimen, usually constituting the *name* of the meteorite, the date of fall or find and the weight of each specimen are shown by its label.

Cases 5 and 6 contain specimens weighing respectively 466 and 345 pounds, of the Kiowa County, Kansas, fall, together with smaller individuals and sections of others of the same fall. In Case 8 are placed a large mass and several hundred smaller fragments of the Phillips County, Kansas, meteorite, the aggregate weight of which is 1184½ pounds.

On the pedestal numbered 12, in the center of the hall, are supported two large masses weighing respectively 1013 and 265 pounds, of the Cañon Diablo, Arizona, meteorite. See Plate III, Fig. 3.

The total number of falls or finds represented by these specimens is 180 and their aggregate weight 4,720.6 pounds, (2,140.4 kilograms).

Cases 7 and 10 are devoted to casts which show the form and size of some of the more notable meteorites, together with specimens of pseudo-meteorites, of the Ovifak iron and of other terrestrial minerals which approximate in composition to those of meteoric origin.

Pedestals 9 and 11 bear full-sized models of the Chupaderos and San Gregorio, Mexico, meteorites, which illustrate the size of these, the largest known bodies of their class.

On the wall is a large map of North America showing the places at which meteorites have fallen or have been found in this country.

Nearly all of the specimens which now make up the collection have been obtained by purchase from Ward's Natural Science Establishment and Mr. Geo. F. Kunz. A section of the Seneca River meteorite has been kindly loaned for exhibition by Mr. G. Murray Guion of Chicago.

It is believed that the collection has already a size and value which entitle it to be considered one of the important ones of this country, if not of the world, and it is hoped that by gifts and exchanges its value may be so constantly increased as to maintain this position, and make it a profitable center for the study of meteorites.

HANDBOOK OF THE COLLECTION.

(In the following pages the figures in full-faced type refer to those on the specimen labels of the collection. From these, therefore, reference may be made to individual specimens of the collection, for the purpose of verifying or exemplifying the statements of the text.)

Meteorites are stony or metallic bodies of extra-terrestrial origin which fall to the earth from space.

They may fall at any time of the day or of the year and on any part of the earth's surface. Their fall is usually accompanied by luminous phenomena, such as the appearance of a ball of fire, showers of sparks and clouds of smoke and by sounds like those of cannonading, of thunder, or of bellowings and rattlings.

Observation of such falls is only occasional, since the larger number of meteorites fall into the sea or upon uninhabited regions. Daubrée calculates that the fall of a meteorite upon some portion of the earth's surface is a phenomenon of daily occurrence, yet the record of observed falls for the past century shows an average of only two and a half a year.

It is known, however, that such bodies have fallen to the earth since the very earliest periods of human history, because some of the most ancient records known to exist, refer to such phenomena.

Being regarded by ancient man and by barbarous tribes as of miraculous origin, they were often carefully preserved, enshrined and worshiped as gods, and thus a knowledge of their existence has come down to us.

Thus a stone which fell in Phrygia at a very early period was long worshiped as Cybele, "the mother of the gods" and about 204 B. C. was removed with great ceremony to Rome. It was described as "a black stone in the figure of a cone, circular below and ending in an apex above," so that it is very probable that it was a meteorite.

The Roman historian Livy tells of a shower of stones which took place on the Alban Mount about 652 B. C., by which the senate was so impressed that it held a solemn festival of nine days in honor of the event.

The famous Diana of the Ephesians and Venus of Cyprus were probably meteoric stones which were worshiped as gods.

The Moslems sacredly preserve at Mecca a stone whose history goes back beyond the seventh century, the descriptions of which leave little doubt that it was of extra-terrestrial origin.

The traveler Pallas found in 1772 a stone at Krasnojarsk (**159**) in Siberia, which was regarded by the Tartars as a "holy thing fallen from heaven." As it has well marked meteoric characters, their tradition regarding it was probably based upon observation of its fall.

A large mass of iron was found in Wichita County (**41**) Texas, a few years ago, which had been set up by the Indians as a kind of "fetich" or object of worship and revered by them as a body foreign to the earth and coming "from the Great Spirit." It was set up at a point where several trails met and was evidently visited periodically by them. This, too, was found upon examination to have the characters of a meteoric iron, so that it is probable that its fall had been witnessed by some member of the race at a previous period.

Ornaments made of meteoric iron have also been found upon the altars of mounds in Ohio, indicating that they may have been used as objects of worship by the Mound Builders.

The Chinese preserve many accounts of the fall of stones from the sky, the earliest recorded being about 644 B. C.

The oldest stone still preserved which is positively of meteoric origin is that of Ensisheim (**207**) Elsass, Germany. This fell November 16, 1492, between 11 and 12 A. M., making a hole about five feet deep in the ground. The stone weighed 260 pounds. King Maximilian being at Ensisheim at the time had it carried to the castle and after breaking off two pieces, one for the Duke Sigismund of Austria and the other for himself, forbade further damage and ordered it to be suspended in the parish church, where it is said it may still be seen hanging by a chain from the vault of the choir.

Although the fact of the fall of stones from the sky seemed thus so well established, the haze of superstition and exaggeration by which the accounts of such occurrences were surrounded was so great that scientific men were slow to believe in the possibility of such a phenomenon.

Moreover the advance of knowledge instead of furnishing additional reason for belief that bodies could reach the earth from the universe beyond, in fact made it seem very improbable. The courses of the heavenly bodies were found to be controlled by such immutable laws that any irregularity seemed impossible. The accounts of stones falling from heaven therefore were generally regarded by

scientific men as the delusion of a few badly scared or very credulous observers.

As proof of this it may be noted that as late as 1772, three French Academicians, among whom was the renowned chemist Lavoisier, having investigated the stone which was said to have fallen at Lucè, France, in 1768, reported that in their opinion it was only an ordinary one struck by lightning.

In the next few years however, meteoric falls occurred under circumstances so accurately defined that their authenticity could not be denied.

On the 13th of December, 1795, at Wold Cottage (**215**) in Yorkshire, England, a stone weighing 56 pounds fell within ten yards of where a laborer was standing, penetrating 12 inches of soil and 6 inches of chalk rock. It was found when examined to be of different character from any ever before known in that region.

No phenomena of sound or light were observed by the laborer, but in the surrounding villages an explosion was heard like the firing of guns at sea and at some points a sound of something unusual passing through the air towards Wold Cottage.

Still more unmistakable was the fall which occurred at Krakhut (**216, 217**) near Benares, India, about 8 o'clock on the evening of December 19, 1798. A ball of fire appeared in a calm and cloudless sky, accompanied by a sound like that of thunder, and then the descent of a number of stones was observed by several Europeans and natives.

Finally at L'Aigle (**218, 220**) in the Department of Orne, France, about 1 P. M. April 26, 1803, occurred a shower of more than a thousand stones, the circumstances attending which were so unmistakable that even the skeptical French Academicians were obliged to give up their doubts. An exhaustive summary of the facts in regard to this fall having been made by the French physicist Biot, his conclusions led the whole scientific world to believe that from time to time, material bodies having an extra-terrestrial origin do come to the earth.

As a result of these conclusions such bodies, which are called *meteorites*, are now as far as possible carefully preserved and the phenomena attending their fall are accurately noted and recorded. The fact that they are the only material bodies which ever reach the earth from the universe beyond it, gives them a peculiar interest, and their study has taught something and may teach yet more of the nature of cosmic matter and forces.

While the meteorites of different falls vary in individual particulars, they all conform to a common type and possess as a whole characters which serve to distinguish them from any terrestrial bodies.

It is therefore possible when any body possessing these characters is found upon the earth, to assert with comparative certainty that it was of meteoric origin though its fall to the earth has not been observed. This is called a meteoric "find" in distinction from a meteoric "fall" and a large number of the meteorites now in collections have been obtained in this way.

This is especially true of the meteorites made up chiefly of iron, since their metallic character preserves them from decay and their weight and difference from ordinary stones make them noticeable to the ordinary observer. On account of the nickel-white color of their interior also, they are often taken by their discoverers for masses of silver and have been preserved for this reason. Of more than one hundred localities of these now represented in collections only nine metallic meteorites have actually been seen to fall.

The meteoric stones, on the other hand, unless their fall has been observed, are far less likely to be discovered, since they differ so little from ordinary stones in appearance that they are easily overlooked and under atmospheric influences quickly disintegrate and decay. Hence most of the stony meteorites now in collections have been seen to fall.

Over 530 distinct meteoric falls and finds are now known, of which the falls number about 270.

It has already been noted that but a small proportion of the meteorites which actually reach the earth are ever secured, since numbers of them fall into the sea or upon uninhabited regions. It will therefore be evident that any conclusions regarding the distribution of meteorites which may be drawn from maps showing where they have fallen must be imperfect and faulty. Such observations as have been made, however, indicate that meteorites are not attracted to any particular portion of the earth's surface and that the point at which they reach the earth is purely a matter of accident.

The times both of the year and of the day, at which meteorites fall, seem to be somewhat more regular.

A table compiled by Mr. R. P. Greg,* shows that more meteorites have fallen in June and July and less in December and January than in the other months.

A similar comparison of data by Haidinger,† regarding the times of day at which meteorites fall, shows that more have fallen in the afternoon than in the forenoon. This is a result, as shown by Professor H. A. Newton,‡ of their movement in direct rather than in retrograde orbits, i. e. of their *following* the earth.

*London Phil. Mag., November, 1854.
†Sitzungsb. d. k., Ak., d. Wissensch., Vienna, 1867.
‡Am. Jour. Sci., 3rd Ser , Vol. 36, p 1-14.

Among characters common to all meteorites which distinguish them from bodies of terrestrial origin may be noted, *first*, the varnish-like *crust* always found upon their surface. This is the result of heating and fusion of the surface during passage of the mass through the atmosphere. In the meteoric stones it is usually black and contrasts with the gray or brown of their interior (Winnebago Co., **340**, Knyahinya, **287**, Pultusk, **290**). Not infrequently, however, it is of the same color as the interior (Kesen, **258**, Washington Co., **345**, and Phillips Co., **350**). It is usually of a dull lustre (Pultusk, **291**, Mocs, **324**), but occasonally shining (Stannern, **226**, Knyahinya, **286**). In many individuals it differs in appearance on different portions of the stone, being smooth and compact on one part and on another, rough and slag-like.

Such appearances often indicate the position which the stone assumed during its fall, the portion bearing the smooth crust having been in advance (*die Brustseite*) while the other portion was at the rear (*die Rückenseite*), (Winnebago Co., **340**, Mocs, **331**). On meteorites which are largely metallic, the crust appears as a brown (Grand Rapids, **116**) or bluish (Estherville, **175**) oxidation of the surface, contrasting with the nickel-white color of the interior. It is never more than a millimeter in thickness (Forsyth, **241**, New Concord, **273**) and frequently exists only as a smoking of the surface (Winnebago, Co., **340**).

Other evidences of surface fusion are seen in the rounded metallic beads which stand out over the exterior of most stony meteorites. These are produced by metallic grains which offer a greater resistance to heat than the non-metallic portions of the stone. Where the metallic grains are quite small, they give the surface a papillated appearance (Trenzano, **268**, Bath, **351**) but larger grains produce larger protuberances (Washington Co., **347**).

Often there are visible on the crust of a meteorite (Stannern, **226**) lines of flow, which closely resemble, though on a much reduced scale, the features of a lava stream, and indicate that the surface of the meteorite was in a similar molten condition.

The rounding of the solid angles and sharp edges observable in most meteoric individuals (Winnebago Co., **340**), even metallic ones (Toluca, **12**, **21**), is likewise evidence of a former plastic condition of the exterior.

A *second* common characteristic of meteorites is to be found in the shallow *pits* which indent their surface. These vary much in size and depth, but usually have an appearance much like that of an impression made by a thumb upon a piece of soft clay or putty.

They are hence often called thumb marks (Phillips Co., **350**, Kesen **257**, Floyd Co., **154**). See Plate V, Fig. 1.

In the iron meteorites these are usually of greater size and depth and occasionally perforate the mass (Cañon Diablo, **146**). See Plate III, Fig. 3.

Similar pittings are observed upon partially burned grains of gunpowder picked up after the firing of the heavy guns at Woolwich, also upon the touch-holes of the cannon and upon masses of steel acted upon by an explosion of dynamite.

They are due in all these cases to the erosive action of gas revolving rapidly and moving spirally under high pressure, which bores into a solid mass with which it comes in contact as resistlessly as a gimlet.

This mechanical action is, moreover, accompanied by a chemical action resulting from the combustible nature of iron at high temperatures.

While at first thought it is difficult to realize how a medium so thin as air can offer resistance to the passage of a meteorite sufficient to fuse its surface, it can be better understood by bearing in mind the fact that air is a fluid made up of molecules as real as those of iron, and physically differing from them only in being more widely separated. A solid body, therefore, in moving through the air, compresses these particles, and by friction against them generates an amount of heat corresponding to its velocity. Experiments made by Joule and Thomson showed that a wire was warmed 1° C. by moving through air at a velocity of 175 feet per second, and that a velocity of 372 feet per second gave a rise in temperature of 5.3° C. Supposing, therefore, that the temperature would continue to increase as the square of the velocity, it can be calculated that a velocity of 20 miles per second, which is the average rate at which meteorites strike the atmosphere, would develop a temperature not far from 360,000°C., in a mass of the same character. We may therefore consider a meteorite in its contact with the atmosphere as exposed to a heat capable of melting it as readily as a piece of tallow is melted by being drawn across white hot iron, so that the wonder is, not that it is so easily fused, but that anything is left of it to reach the earth.

We are thus able also to understand the phenomena of light, of clouds, of smoke and of sounds like thunder or of an explosion, which usually accompany the fall of a meteorite.

The intense heat raises to incandescence the surface of the meteorite, causing it to glow with a light so powerful as occasionally to be visible at noon-day. The heated stratum of air agglomerates be-

hind the advancing mass in the form of an igneous globe, making a flame shaped like that of a candle, and under the intense heat a large portion of the mass is dissipated into a vapor or smoke. The heat moreover, causes cracking of the surface (Linn Co., **255**, Dona Inez, **193**) and an unequal expansion of the mass which bursts it, often with explosive violence.

In spite of the high temperature to which its surface is raised, however, the substance of the meteorite is so poor a conductor that its interior is often scarcely heated at all. When picked up immediately after their fall, therefore, meteorites are often scarcely more than blood warm and in one remarkable instance, that of the Dhurmsala (**275**) meteorite, the fragments were so cold as to benumb the fingers of those who collected them. This is perhaps the only instance known in which the cold of space has become perceptible to human senses.

Another effect of the passage of a meteorite through the earth's atmosphere is to reduce very greatly its velocity, so that the speed of its fall when near the earth is comparable to that of an ordinary falling body. Hence instead of striking the earth at a velocity of from 10 to 45 miles a second, which is that at which meteorites enter the atmosphere, their force of impact may be very small. This is shown by the fact that several stones of the Hessle (**298**) fall, struck upon ice which was only a few inches thick and rebounded without either breaking the ice or being themselves shattered.

By dissipating, therefore, the smaller stones before they reach the earth and by reducing both the size and velocity of those which do come to it, the atmosphere protects us from what would otherwise be a dangerous bombardment, and makes the chances of injury to life or property from the fall of these bodies exceedingly small.

The *forms* of meteorites are very various and possess little regularity. Many are spheroidal (Pultusk, **290**), some oblong (Babb's Mill, cast, **383**), some tetrahedral (Mocs, **330**), some shell-like as if scaled from a spherical mass (Cañon Diablo, **373**) and many so irregular as to be lacking any definite form. They are as a rule as indefinite as to size and shape as the fragments from any block of stone when shattered with a hammer and it is therefore probable that they have been formed by the breaking up of a larger mass.

Such a disruption of a meteorite often takes place shortly before it reaches the earth, and as a result many individuals of a meteoric shower possess edges which are still rough and jagged and show little fusion of the surface (Winnebago Co., **340**). Perhaps the most remarkable instance of this is furnished by the stone of the Butsura (**398**)

fall. At the time of fall of this meteorite three distinct reports were heard and five different fragments were picked up at four places several miles apart. Three of these fragments were found to fit together perfectly and at the points of contact to exhibit no crust, though their other surfaces were coated with it. The point of junction of the other two fragments could also be made out, though this surface possessed a crust hardly distinguishable from that of the rest of the mass. It was also found possible to unite all the fragments into one shell-like mass, showing that this was probably a unit as it entered the atmosphere and that the successive disruptions took place during its passage to the earth.

Similar variations in crust are observable among the individuals of nearly every meteoric shower, making it seem probable that they are produced by the breaking up of a single individual.

It should be noted, however, that some authorities prefer to regard the stones of a meteoric shower as members of a *swarm* of larger or smaller planetary individuals which had a previous independent existence.

In *size*, meteorites vary from complete individuals no larger than a pea (Winnebago Co., **340**) to the enormous mass of Chupaderos, Chihuahua, Mexico (Model **422**) whose weight has been variously estimated at from fifteen to twenty-five tons. The Phillips Co., Kansas, meteorite (**350**) if it reached the earth, as is highly probable, in a single mass, is the largest single äerolite in existence, the aggregate weight of the fragments so far found being 1300 pounds. The next largest is an individual of the Knyahinya, Hungary, fall, preserved in the Vienna Museum, having a weight of 647 pounds. Among the äerosiderites or iron meteorites, however, there are many of greater size and weight, as for example the Cranbourne (**68**) mass now preserved in the British Museum, which weighs about four tons, the Red River or Gibbs meteorite (**34**) in the Yale College Museum, weight 1630 pounds, and several Mexican meteorites.

The chemical study of meteorites has shown them to be made up of *elements* such as are common upon the earth and has as yet revealed none new to its constitution. About twenty-five have thus far been recognized, of which iron, silicon, magnesium, nickel, sulphur, phosphorus and carbon are the most important. The following list represents all that are known to occur:

Aluminium	Chlorine	Iron	*Nitrogen	Sodium
Antimony	Chromium	Lithium	Oxygen	Sulphur
Arsenic	Cobalt	Magnesium	Phosphorus	Tin
Calcium	Copper	Manganese	Potassium	Titanium
Carbon	Hydrogen	Nickel	Silicon	

*Recent investigations by Prof. Ramsay have shown that what has been regarded as nitrogen, is largely made up of argon and helium. See Nature Vol. 52, p. 224.

These are usually present in combination, but hydrogen and nitrogen occur as occluded gases and carbon in the elementary form of graphite or diamond.

The following *compounds* occur, which in chemical composition and physical properties seem to be wholly similar to terrestrial minerals of the same name:

The silicates, chrysolite $(Mg, Fe)_2\ Si\ O_4$, enstatite, $Mg\ Si\ O_3$, bronzite, $(Mg, Fe)\ Si\ O_3$, diopside including diallage, $Ca\ Mg\ (Si\ O_3)_2 + Ca\ (Mg, Fe)\ (Si\ O_3)_2$, augite, $Ca\ (Mg, Fe)\ (Si\ O_3)_2 + (Mg, Fe)\ (Al, Fe)_2\ Si\ O_6$, labradorite, $(Na\ Al\ Si_3\ O_8 + Ca\ Al_2\ Si_2\ O_8)$ and anorthite, $Ca\ Al_2\ Si_2\ O_8$; the oxides, magnetite, $Fe\ O, Fe_2\ O_3$ and chromite, $Fe\ O, Cr_2\ O_3$; the sulphides, pyrite, $Fe\ S_2$, and pyrrhotite, $Fe_7\ S_8$, and the carbonate, breunnerite $Mg\ Co_3$ with $Fe\ O$.

Quartz, $(Si\ O_2)$, though so widely distributed upon the earth, is conspicuous by its absence from meteorites. Small crystals have, however, recently been observed in the crust of some of the Toluca irons,* and free silica occurs in several meteorites in the form of asmanite, a compound believed to be identical with tridymite. Zircon, $(Zr\ Si\ O_4)$ has also been found in one of the Toluca masses, and the presence of orthoclase, garnet and apatite in several meteorites is probable, though not proved. Several soluble salts, such as chloride of sodium, and sulphates of sodium, calcium and magnesium, have been found in meteorites, and the carbonaceous meteorites contain bituminous substances which closely resemble terrestrial bitumens. As occluded gases occur marsh gas and carbon monoxide and dioxide.

The soluble salts and breunnerite are regarded by Cohen as of secondary origin, i. e., formed after the entrance of the meteorite into the earth's atmosphere, and the same may be true of the gases and bituminous substances. Various other compounds found in meteorites have from time to time been described as distinct species but their identity with terrestrial minerals has later been established.

The following compounds found in meteorites are believed to have no representatives among terrestrial minerals:

Various alloys of nickel and iron, including taenite, $Fe_6\ Ni$, kamacite, $Fe_{14}\ Ni$, plessite, $Fe_{28}\ Ni_5$ and edmonsonite; chalypite, a compound of iron and carbon; cliftonite, a cubic form of graphitic carbon; cohenite, $(Fe, Ni, Co)_3C$; schreibersite, $(Fe, Ni)_3\ P$; troilite, $Fe\ S$; oldhamite, $Ca\ S$; osbornite, supposed to be a sulphide or oxysulphide of calcium and probably titanium; daubréelite, $Fe\ S, Cr_2\ S_3$, and lawrencite, $Fe\ Cl_2$.

The chemical character of these compounds indicates that the conditions under which they were formed differed from those which

*Groth's Zeitschr für Kryst. und Min., Bd. 24. p. 485.

prevail upon the earth, in the absence of air or free oxygen and of water. The lack of the first is indicated by the phosphide of iron, schreibersite, which would, in the presence of oxygen, have been changed to a phosphate; also by the fact that the iron and nickel are in the elementary condition and not oxidized, as they are upon the earth's surface. The absence of water is proved by the fact that no hydrous minerals are present in meteorites.

It is known that either the atmosphere in which the meteorites were formed or one through which they at some time passed, contained a large amount of hydrogen, from the fact that it can be extracted in large quantities from some of the metallic meteorites. It was, too, under a much higher pressure than is that of the earth's atmosphere, since Graham obtained from the Lenarto meteorite 2.85 times its volume of mixed gases, of which hydrogen formed 85%. Under the pressure of the earth's atmosphere it is difficult to make iron absorb more than its own volume of this gas. The reducing action of this hydrogen-laden atmosphere must be very great and in general it may be said that meteorites differ from analogous terrestrial rocks in containing in a reduced state substances which occur as oxides upon the earth.

Considered as *mineral aggregates*, meteorites may be conveniently divided into three classes according as they are made up chiefly of iron, partly of iron and partly of stone or chiefly of stone.

The meteorites of the first class have been called by Maskelyne *äerosiderites* (from ἀήρ, air, and σίδηρος, iron) or by Daubrée *holosiderites*, (ὅλος, whole, σίδηρος, iron). The term is frequently shortened to *siderite* but the abbreviation is objectionable on account of the liability of its confusion with the mineral of the same name. The meteorites of the second class are called by the same authors *äerosiderolites* (ἀήρ, air, σίδηρος, iron, and λίθος, stone) or *syssiderites* (σύν, with, σίδηρος, iron). Those of the third class are known as *äerolites* (ἀήρ, air and λίθος, stone,) or by Daubrée are divided into the two groups of *sporado-siderites* (σποράς, scattered, σίδηρος, iron,) and *asiderites* (ἀ without, σίδηρος, iron.)

The *äerosiderites*, as is indicated by their name, are made up chiefly of iron. This is, however, always alloyed with nickel. The percentage of iron in the mass varies between 87% and 97% and that of nickel from a fraction of one per cent to 15%.

Two exceptions to this are known among irons supposed to be meteoric. One is that of Octibbeha Co., Miss., which contains 38% of iron to 60% of nickel and the other that of Santa Catarina, Brazil (97-108) which bears 64% of iron to 34% of nickel. It is possible, however, that the latter is of terrestrial origin.

The association of iron and nickel in the form of an alloy was long thought to be a peculiarity of meteoric bodies, but at least two terrestrial minerals are now known, which are constituted of such an alloy. One of these, awaruite (**361**), contains 67% of nickel to 31% of iron, the other, josephinite (**367**), 60% of nickel to 23% of iron.

The iron found in large masses on Disco Island and other parts of West Greenland also resembles the äerosiderites very closely in composition, since it contains from 1 to 6% of nickel and small percentages of phosphorus and carbon.

These occurrences are so isolated, however, that in general, masses of iron alloyed with nickel, when found upon the earth's surface, may be regarded as being probably of meteoric origin, especially if they also exhibit a crust and pitted surface like that described, and etching figures such as will be mentioned later.

Other elements commonly occurring in the äerosiderites, though in much smaller quantities, are copper, cobalt, manganese, phosphorus, sulphur and carbon.

The phosphorus is usually combined with iron in the form of schreibersite, the sulphur with iron as troilite, while the carbon may be either free in a graphitic form or as minute diamonds, or combined with iron.

The proportions of the different elements as they commonly occur in the äerosiderites are illustrated by the following analyses of some of those represented in the collection:—

			Fe.	Ni.	Co.	Cu.	P.			
(1)	Toluca,...	(**7**)	90.72	8.49	0.44	....	0.18	X .63		=100.46
(2)	Braunau	(**55**)	91.88	5.52	0 53	2.07	....	C, S *tr.*		=100.
(3)	Bates Co., Mo......	(**95**)	89.12	10.02	0.26	0.01	0.12			= 99.53
(4)	Grand Rapids, Mich.	(**116**)	88.71	10.69	....	0.07	0.26	C.06	S.03	= 99.82
(5)	Glorieta Mt., N. M.	(**122**)	87.93	11.15	0.33	....	0.36			= 99.77
(6)	St. Croix Co., Wis..	(**125**)	89.78	7.65	1.33	*tr.*	0.51	C *tr.*	Sn *tr.*	= 99.27

The specific gravity of the meteoric irons ranges between 5.75 and 8.31, nearly all lying between 7.5 and 7.9.

Most meteoric irons present a distinct *crystalline structure*, the features of which are brought out by etching a polished surface with acids. There then appear upon the surface, bands or lines intersecting one another at various angles, according to the direction of the section. These are enclosed in a more or less unindividualized ground mass.

(1) Taylor, Am. J. Sc. Vol. 22 p. 374, 1856; (2) Duflos and Fischer, Pogg. Ann. Vol. 72, pp. 170, 475, 1847; (3) J. L. Smith, Am. J. Sc. 3rd series, Vol. 13, p. 213, 1877; (4) Riggs, ibid, Vol. 30, p. 312, 1885; (5) Mackintosh, ibid, Vol. 30, p. 238, 1885; (6) D. Fisher, ibid, Vol. 34, p. 381, 1887. For further analyses see Lithological Studies by M. E. Wadsworth, Mem. Mus. Comp. Zool., Harvard Coll., Vol. XI, Part I, Oct. 1884.

Upon close examination the bands are found to be made up of a broad, central plate depressed below the surface, which is bounded by narrow ones in relief. These are shown in Figs. 1 and 2, Plate II.

Analysis of these plates by Reichenbach has shown that the broader ones are made up of an alloy of nickel and iron containing a large percentage of iron and hence readily dissolved by the acid. This alloy he called *kamacite*. The narrow plates, made up of an alloy which he called *taenite*, contain a larger percentage of nickel, are less readily dissolved and hence stand out in relief. The ground mass, to which he gave the name of *plessite*, he considered as having a proportion of iron and nickel between the two. Recent investigations by Davison,* however, indicate that there may be but two alloys present, the plessite representing simply portions of the mass where the bands of taenite are so closely crowded as to protect the kamacite from the action of the acid. This is rendered more probable by observing the insensible gradations by which the finer lines, called by J. L. Smith Laphamite markings, pass into the ground mass as if there were no real division between them. See Plate II, Fig. 1.

The angles at which the bands meet are dependent, as has been stated, upon the direction of the section and also upon their parallelism to the faces of either the octahedron, cube or dodecahedron, of the isometric system. All of these planes may occur in one meteorite but commonly only those of one kind appear and give to the iron a characteristic structure, distinguishing them as either octahedral or cubic.

The varying thickness of the plates and differences in their angles of intersection produce a variety of figures which characterize irons of different falls. See Plates I, II and III. Since they were first described by Widmanstätten, they are called Widmanstätten figures. They form one of the most striking features of the metallic meteorites and were long thought to be peculiar to such bodies, but are now known to be imitated by the etching figures of steel and of the native iron of Greenland. They have been produced by Daubrée upon a mass artificially formed by fusing together iron, nickel and phosphides of iron and nickel. They are, therefore, rather to be considered as indicative of the conditions under which the meteoric mass originated than as representing any distinct property of extra-terrestrial matter.

As examples of coarse etching figures, *i. e.* those made up of broad bands, may be noted sections of the Toluca (16), Staunton (79), Robertson Co. (83) and Cañon Diablo (147), irons. More delicate fig-

*Am. J. Sc. 3rd ser., Vol. 42, p 64.

ures, *i. e.* made up of narrower bands, can be seen in the Lion River (**62**), Smith's Mt., N.C. (**85**), Bear Creek (**89**), Bates Co., Mo. (**96**) and Hamilton Co., Texas (**131**), irons.

The finer lines were regarded by Neumann as indicating an essentially different structure from that shown by the Widmanstätten figures and they are hence often called Neumann lines.

As pointed out by Huntington,* however, every gradation can be traced between the coarsest Widmanstätten figures and finest Neumann lines, so that there is no reason for regarding them as distinct. In Huntington's view the coarser figures characterize the irons in which there was a large amount of foreign matter to be eliminated, the finer, the purer irons. The former moreover tend to an octahedral structure, the latter, a cubic.

Most authorities agree that the crystalline structure exhibited in the meteoric irons indicates that they remained for a long time in a fused or viscous state from which they cooled but slowly.

Thus Tschermak† states that "the greater number of meteoric irons exhibit a structure which indicates that each formed part of a large mass possessing similar crystalline characters and the formation of such large masses presupposes long intervals of time for tranquil crystallization at a uniform temperature". Sorby‡ also regards "the Widmanstätten figures as the result of such a complete separation of the constituents and perfect crystallization as can occur only when the process takes place slowly and gradually. They appear to me to show that the mass was kept for a long time at a heat just below the point of fusion."

Further evidence of this is seen in the curved or bent plates contained in some meteoric irons (Stutsman Co., **126**), which were probably formed as true planes but, remaining viscous longer than other portions of the mass, suffered subsequent distortion.

It should be noted that there are some irons usually regarded as meteoric, which exhibit no trace of the Widmanstätten figures (Chesterville, **56**, Allen Co., **92**, Maverick Co., **113**). Others show only a coarse, irregular network of markings (Seeläsgen, **375**, Puquois, **124**, Silver Crown, **130**).

These may be considered as having been formed under somewhat different conditions from those which prevailed in the formation of other meteoric irons, or it may be questioned whether they are not of terrestrial origin.

*Proc. Am. Acad. Arts and Sciences, May, 1886, also Am. J. Sc., 3rd ser., Vol. 32, p. 284.
†Sitz. Wien. Akad., 1875, Bd. 71, pp. 661-673.
‡Nature, 1877, Vol. 15, p. 498.

Other markings which may be noted upon the etched surfaces of many irons are produced by included nodules of troilite. These may take various forms, such as circular (Orange River, **72**, Allen Co., **91**), oval (Staunton, **80**), elongated (Toluca, **25**), radiated (Hamilton Co., **131**), or running in veins (Joe Wright Mountain, **121**).

Occasionally there appear upon the etched surfaces delicate, short, sunken lines running in parallel directions or intersecting at regular angles (Walker Co., **38**, Maverick Co., **113**, Hex River Mts., **115**). According to Brezina these mark also the position of inclusions of troilite.

Other scattered, irregular flakes of a bronze-like lustre, indicate the presence of schreibersite (Wichita Co., **41**, Careyfort, **50**, Youndegin, **118**).

Together with the crystalline structure many äerosiderites display well-marked cleavage, usually octahedral (Toluca, **17**, Henry Co., **136**, Kenton Co. **134**) but occasionally cubic (Braunau, **55**) or dodecahedral. This structure is also possessed by some irons which exhibit no etching figures whatever, and in general seems to be independent of the crystalline planes because the cleavage planes frequently pass through the crystalline plates, indicating that they are of separate origin.

The *äerosiderolites* consist usually of a spongy mass of nickeliferous iron in the pores of which are contained grains of silicates. The silicate most commonly found occurring in this way is chrysolite and its typical mode of occurrence is shown in the Krasnojarsk (**159**) meteorite. This meteorite, having been first reported by the traveler Pallas in 1776, is frequently known as the Pallas iron, and the name Pallasite is given to meteorites of this class. Those of Kiowa Co., (**200**) are excellent examples.

In the Rittersgrün meteorite, (**164**) the pores of the iron are filled with a mixture of asmanite and bronzite, in that of Atacama (**170**) with chrysolite mingled with pyroxene and chromite; in that of Estherville (**177**) with chrysolite, diallage, pyrrhotite and troilite. The äerosiderolites pass so gradually from the äerosiderites on the one hand to the äerolites on the other that their grouping as a distinct class is adopted only for convenience. Occasionally, too, in individuals of the same fall, both classes are represented. Thus some of the Kiowa Co. meteorites are true pallasites (**200, 202, 206**) while others are entirely metallic (**204, 205**). Among the stones of the Estherville (**175, 178**) fall, can be traced every gradation between äerosiderolites and äerolites.

Upon the metallic portions of the äerosiderolites the Widmanstätten figures can usually be brought out (Atacama **162**. Rockwood **184**) and, as these are quite similar to those of the wholly metallic meteorites, they indicate the existence of corresponding conditions in the formation of the mass.

Analyses of some of the äerosiderolites represented in the collection show the following composition:—

	(1) Atacama, Chile. (**160**)	(2) Krasnojarsk, Siberia. (**157**)	(3) Rittersgrün, Saxony, (**164**)	(4) Carroll Co., Ky. (**180**)	(5) Hainholz, Prussia. (**165**)
SiO_2	13.60	20.43	26.79	29.52	33.24
Fe	60.27	44.02	Fe+Ni. 50.41	20.48	4.12
Fe_2O_3					22.20
FeO	4.09	6.86	3.53	14.11	3.51
Al_2O_3	0.01	MnO 0.21	0.70		0.72
CaO			0.66		
MgO	15.68	23.67	6.31	31.37	30.52
Ni	5.73	5.37	Na_2O 0.48	4.22	1.05
Co		0.23		0.28	
Cu		0.03	0.02	P 0.02	Cr_2O_3+FeO 0.50
Sn			FeS 7.23		
H_2O					2.86
Insol	0.20	0.24			
	99.58	101.07	96.13	100.00	98.72
Sp. Gr.	6.16	5.44	4.29	4.41	4.61

From meteorites of this class every gradation can be traced to the *äerolites*, meteorites in which the stony or siliceous matter predominates. These usually contain scattered metallic grains, *sporadosiderites* of Daubrée (Kesen, **257**, New Concord, **274**, Homestead, **314**), but some show no metallic constituents whatever, *asiderites* of Daubrée (Alais, **221**, Juvinas, **237**). The äerolites are made up chiefly of the minerals chrysolite, bronzite, augite, enstatite or some other member of the pyroxene group, anorthite or other feldspar, chromite, nickel-iron and troilite. These are usually crystallized and occur in angular, splintery fragments, but are sometimes developed porphyriti-

(1) Von Kobell and Rivero, Korrespondenz-Blatt Vereines Regensberg, 1851. Recalculated by M. E. Wadsworth on the supposition that the silicates constitute one-third of the mass.

(2) J. J. Berzelius, Ann. Phys. u. Chemie 1834, Vol. 33, pp. 123—135.

Recalculated by M. E. Wadsworth on the supposition that the silicates compose one-half of the mass.

(3) C. Winkler, Nova Acta Leop. Acad. Halle, 1878, Vol. 40, pp. 333, 282.

(4) J. B. Mackintosh, Am. J. Sc. 3rd ser, Vol. 33, p. 232. Mar. 1887. Recalculated by the author on the supposition that the silicates constitute three-fourths of the mass.

(5) C. Rammelsberg, Mon. Berlin Akad., 1870, pp. 322—325.

Other analyses may be found in the work of Wadsworth, previously cited.

cally in an amorphous or crypto-crystalline ground. The occurrence and association of these minerals is similar to that in the eruptive rocks of the earth, and these they closely resemble. Representatives of many of the different varieties of eruptive rocks can indeed be found among the äerolites, so that, in the view of Wadsworth, no distinctions in classification should be made between rocks of terrestrial and extra-terrestrial origin if they resemble one another in constitution. Thus the äerolites containing no feldspar and made up chiefly of chrysolite are classed by him with the peridotites, the different varieties finding representatives as follows:—Dunite, a rock made up chiefly of chrysolite and chromite, is represented by the meteorite of Chassigny; saxonite, composed of chrysolite and enstatite, by those of Homestead (**313**) Knyahinya (**284**) and Waconda (**389**); lherzolite, made up of chrysolite, enstatite and diallage, by those of Pultusk (**289**) and New Concord (**274**).

Similarly the äerolites containing feldspar may be considered as corresponding to the basalts and gabbros in mineralogical constitution; basalt, made up of augite and anorthite, finding a representative in the stones of the Stannern (**225**) fall; gabbro, composed of anorthite and enstatite, in the meteorite of Juvinas (**237**).

While such a grouping is convenient for keeping in mind the mineral constitution of the different äerolites, it is doubtful whether its application should be pushed much farther, since the distinction of origin is one of considerable importance.

The classification suggested by Tschermak* for the äerolites is as follows:

I. Äerolites made up of chrysolite and bronzite with iron subordinate, texture mostly chondritic. (L'Aigle, Knyahinya, New Concord, Pultusk, etc.)

II. Äerolites made up chiefly of chrysolite or bronzite or other pyroxene.

(a) Chassignite, composed mostly of chrysolite. (Chassigny.)

(b) Amphoterite, composed of chrysolite and bronzite. (Manbhoom.)

(c) Diogenite, composed of bronzite or hypersthene. (Ibbenbuhren, Shalka.)

(d) Chladnite, composed of enstatite. (Bishopville).

(e) Bustite, composed of diopside and enstatite. (Busti).

III. Äerolites made up of augite, bronzite, and lime feldspar and having a shining crust.

(a) Howardite, composed of augite, bronzite and plagioclase, (Frankfort, Lontolaks.)

(b) Eukrite, composed of augite with anorthite or maskelynite. (Juvinas, Jonzac, Stannern, Peterborough.)

*Ber. Ak. Wien., Bd. 88, pp. 347, 371, 1883.

Following are analyses of some of the äerolites represented in the collection:—

	(1) Pultusk, Poland. (289)	(2) Iowa County, Iowa. (312)	(3) Schönenberg, Bavaria. (254)	(4) New Concord, Ohio. (273)
$Si O_2$	35.85	36.34	40.13	42.25
Al_2O_3	1.96	0.63	5.57	0.28
Fe	15.55	11.16	13.77	9.31
$Fe_2 O_3$	3.85			
Fe O	12.12	22.28	17.12	25.03
Ca O	1.56		2.31	0.02
Mg O	24.95	19.70	13.81	21.91
$Na_2 O$	0.95	1.40	2.20	0.99 (Na_2O + K_2O)
$K_2 O$	0.39	tr.	0.73	
$Cr_2 O_3$	2.21		0.60	
Ni		1.30	1.47	1.32
Co		0.08		0.04
$Li_2 O$		tr.		
P			0.36	tr.
S			1.93	0.11
Fe S		5.82		
	99.39	98.71	100.	101.26

	(5) Knyahinya, Hungary. (284)	(6) Stannern, Moravia. (225)	(7) Juvinas, France. (237)	(8) Bishopville, S. C. (251)
$Si O_2$	44.30	48.30	49.23	67.14
$Al_2 O_3$	3.06	12.65	12.55	1.48
Fe			0.16	
$Fe_2 O_3$			1.21	1.71
Fe O	16.38	19.32	20.33	
Ca O	2.73	11.27	10.23	1.82
Mg O	22.16	6.87	6.44	27.12
Mn O		0.81		*tr.*
$Na_2 O$	1.00	0.62	0.63	
$K_2 O$	0.66	0.23	0.12	
$Cr_2 O_3$	0.80	+ Fe O 0.54	0.24	
Fe + Ni	5.00			
$P_2 O_5$			0.28	
S			0.09	
$H_2 O$				0.67
Fe S	2.22	tr.		
$Ti O_2$			0.10	
	98.31	100.61	101.61	99.94

(1) C. Rammelsberg, Mon. Berlin Akad. 1870, pp. 418-452.
(2) J. L. Smith, Am. J. Sci. 1875, 3rd ser., vol. 10, pp. 362-363.
(3) C. W. Gümbel, Sitz. München Akad., 18 8, vol 8, pp. 40-46.
(4) J. L. Smith, Am. J. Sci. 1861, 2nd ser., vol. 31. pp 87–98.
(5) E. H. von Baumhauer, Archives Néerland, 1872, vol. 7, pp. 146–153.
(6) C. Rammelsberg. Ann. Phys. u. Chem., 1851, vol. 83, pp. 591–593.
(7) C. Rammelsberg, Ann. Phys. u. Chem., 1848. vol. 77, pp. 585–590.
(8) W. S. von Waltershauser, Ann Chem. u. Phar., 1875, vol. 79, pp. 369–374.

In specific gravity the majority of äerolites range from 3.00 to 3.80, being on the whole heavier than terrestrial rocks of the same nature on account of the greater quantity of metallic constituents.

Viewed as to *structure* the greater number of äerolites are found to be made up chiefly of little spheres, varying in size from those as large as a cherry to those only visible under the microscope. These are called *chondri* from the Greek *χονδρος*, a ball, and meteorites possessing this structure are said to be *chondritic.*

The chondritic structure is often discernible by the naked eye, as may be seen in the specimens of Weston (**224**), Forsyth (**240**), Pusinsko (**250**), Trenzano (**268**), Knyahinya (**284**) and many others.

When examined with sufficient magnifying power the chondri can be seen to be composed of angular, crystalline fragments chiefly of chrysolite or some pyroxene. See Plate VI, Fig. 1. These may be present as one individual (monosomatic) or more commonly of several (polysomatic).

An eccentric fan-shaped chondrus made up of radiating fibres of enstatite is a very unique and characteristic form. One such may be noted in the section of the Simbirsk meteorite, shown in Plate VI, Fig. 1. Other arrangements of the grains or fibres which may be noted are concentric, reticulated and radiated.

The chondrus is frequently enclosed in a shell of metallic grains which gives it a distinct outline and separates it from the ground mass. This is illustrated in Plate VI, Fig. 2.

The conditions which have brought about the formation of these chondri are not well understood though the question has been much discussed and various hypotheses have been suggested. The views of earlier observers were to the effect that the chondri represented fragments of pre-existing rock which by oscillation and consequent attrition obtained a spherical form. Sorby* has regarded them as produced by cooling and aggregation of minute drops of melted stony matter. Tschermak† considers their origin similar to that of the spherules met with in volcanic tuffs, which owe their form to prolonged explosive activity in a volcanic throat, breaking up the older rocks and rounding the particles by constant attrition.

Different views are, however, set forth by Brezina‡ and Wadsworth§, who believe that the chondri have been produced by rapid and arrested crystallization in a molten mass.

---

*Geol. Mag. 1865 (1) ii, 447.

†Phil. Mag. 1876 (5) i, 497-507.

‡Die Meteoritensammlung in Wien, 1885, p. 19.

§Lithological Studies, p. 110.

The principal objection to the first view, pointed out by Wadsworth, is that fragments of pre-existing rock ought to show the constitution of the rock as a whole instead of a specialized structure. That to the second, pointed out by Merrill* in the case of the San Emigdio meteorite at least, is that the great variety of forms under which the minerals of a single stone often appear, make it impossible to conceive of them as crystallizing from a single magma.

It is evident that no positive answer can be given to the question as yet and it may be that the conditions under which the various structures have been produced have been essentially different.

The matrix or mass of the stone in which the chondri are imbedded is usually made up of consolidated mineral splinters such as might have been produced by the breaking down of the chondri themselves. It is occasionally, however, of a glassy or amorphous nature.

The structure of äerolites not chondritic is frequently brecciated (Weston, **223**, Taborg, **335**) i. e., made up of rock fragments cemented together, while others seem to have undergone metamorphism subsequent to their consolidation (Chantonnay, **232**).

Evidence of physical change subsequent to consolidation is given by the *slickensided* surfaces observable in many meteorites (Linn Co., **255**, Kesen, **267**, Bath, **351**).

These are smooth, polished surfaces seen in different portions of the mass and are analogous to those found along faults in terrestrial rocks. They indicate a slipping or gliding of one portion of the rock on another after it had become cooled and solidified.

In the Puquios meteorite, which has a mass wholly metallic, a distinct faulting was observed by Howell. As some of the Toluca irons were found to become extremely friable on heating, it is probable that this faulting might have taken place during the passage of the mass near the sun or some other hot body.

Veins are found penetrating the mass of many meteorites (Charsonville, **230**, Waconda, **310**, Mocs, **323**). These are frequently filled with metal (Schönenberg, **254**, Washington Co., **327**, a) and in this case may have been produced as suggested by Preston by flowing of the molten metal into fissures made by cracking of the mass during its passage through the air. Others, however, contain opaque, graphitic or amorphous substances which probably segregated previous to the entrance of the meteorite into the earth's atmosphere.

A class of meteorites in the formation of which igneous agencies could have played little part are those known as *carbonaceous*. These are black, very friable bodies having a specific gravity not over 2.00

*Proc. U. S. N. M. No. 11, 1888.

and containing carbon compounds closely resembling terrestrial bitumens. Notably in the Cold Bokkeveld meteorite (**246**) occurs a substance much like bitumen from which a wax-like hydrocarbon can be dissolved out by alcohol. Other examples of carbonaceous meteorites, are those of Alais (**221**), Orgueil (**282**), Entre Rios (**320**), and Kaba.

As these carbon compounds seem to exist only in the pores of the stone, it has been suggested by Maskelyne that they may have been absorbed during its passage through the atmosphere, but this is not certain. Besides the carbon compounds, some meteorites of this class contain soluble alkaline salts which act as a cement to consolidate the meteorite, but when moistened with water cause it to completely disintegrate. These salts are sulphates of sodium, calcium, magnesium and potassium.

Having thus traced in outline the principal characters of meteorites there remains for answer the interesting question as to what has been the probable origin of these bodies. While it is not the province of this Handbook to enter into any elaborate discussion of the question, a study of meteorites can hardly be considered complete without a mention of some of the different theories which have been proposed to account for their origin.

It is evident, as has been said, from the chemical character of the substances found in meteorites, that water and air must have been absent from the laboratory of nature in which they were formed.

It is apparently true also that life had nothing to do with the formation of the substances which meteorites contain. The constituent substances most likely to have been of organic origin are the hydro-carbons previously mentioned, which resemble terrestrial bitumens. The latter are generally regarded as being one of the products of the decomposition of vegetable matter, but that they may have had a mineral origin as well is not denied, so that the presence of similar substances in meteorites is no proof of previous life.

The close resemblance which äerolites bear to volcanic terrestrial rocks has led many to seek their origin in material ejected from the volcanoes of the earth or moon.

This view has had many able supporters, notably the astronomer Laplace and the mineralogist J. Lawrence Smith. A careful study however of the amount of projectile force required to throw the meteoric bodies beyond the attraction of the terrestrial or lunar sphere and of the amount of matter which must have been thus ejected in order to furnish the number of meteorites that have been observed, shows both to be far beyond any probable quantity.

It may also be urged against this view that the volcanoes of the moon are not now active and the chances are exceedingly few that matter thrown from them in times past, once missing the earth, would ever reach it again. Also that from terrestrial volcanoes no substances like those forming the metallic meteorites have ever been ejected, and that, while in general the äerolites resemble volcanic rocks, they are in fact so distinct as to be readily distinguished from them.

Another view which has been seriously urged is that meteorites have had a solar origin.

Such a hypothesis, however, requires that solid bodies, some of them combustible, should come from the hot sun, and further that their paths should be in a line parallel to the ecliptic. The latter is not the case with the paths of many meteorites.

By another hypothesis meteorites are regarded as having come from a shattered planet. It is evident from the facts just stated that such a planet could have had no atmosphere. The supposition however that it ever existed is purely an arbitrary one, as is also that of any internal force which could rend it in pieces. Moreover, from such a body we should expect fragments varying more in size than do those which have thus far come to us.

We must therefore look to some other source for the answer to our question. The preponderance of opinion at the present day seems to be that it may be found in those strange, erratic bodies, the comets.

We know that these are worlds without water, with a strange and variable envelope which takes the place of an atmosphere, worlds which travel repeatedly out into the cold of space and back to the sun and slowly go to pieces in the process. Such conditions correspond closely with those which we have already seen probably prevailed in the formation of meteorites.

Still stronger evidence of the cometic origin of meteorites is to be found in the similarity between the orbits of groups of meteors and those of certain comets. In 1866, Schiaparelli, having calculated the orbit and motion of the meteorites which produce the annual August star shower, found that they corresponded exactly with those of an observed comet. Later the orbit of Tempel's comet was found to accord with that of the meteors of the November star shower and other parallelisms were noted for smaller showers. More remarkable still is the evidence afforded by the history of Biela's comet. This comet, discovered in 1826 by Captain Biela, was found to have a period of revolution of 6.6 years and to regularly come into view

at these intervals. It had previously been seen in 1772 and 1805 and returned to the solar system in due order in 1832. Being in an unfavorable position in 1839 it could not be seen, but at the time of its next appearance in 1846 it was found to have separated into two portions, which kept drifting farther apart during the time in which the comet remained visible. At its next appearance in 1852, the fragments were seen to be smaller and still more widely separated. In accordance with its times of revolution the comet should have reappeared in 1859, 1866, 1872, 1879 and 1885, but though carefully looked for, it has never been seen again.

On November 27, 1872, however, occured a meteoric shower extraordinary for the number and brilliancy of the meteors which flashed through the air. The orbit of these proved to be exactly that of Biela's comet. On the same date in 1885 occurred another remarkable shower of meteors, having the same orbit and radiant point as those of 1872. During this shower an iron meteorite weighing about 8 pounds fell at Mazapil in Mexico. The manifest conclusion, therefore, is that sometime between the years 1852 and 1872, Biela's comet was shattered in pieces and some of these meteors were the resulting fragments. These fragments being small, were mostly burned up in their passage through the upper part of the earth's atmosphere, but had they been larger, numbers of meteorites would probably have fallen to the earth.

The fact, however, that so few meteorites have fallen to the earth during the star showers has been urged by some authorities as proof that the meteors producing stones are of a different nature from those which we see only as shooting stars. Since however, every gradation may be traced from one to the other and astronomically they are all alike, there is little reason, in the view of many authorities, to doubt their similarity.

Attention has already been called to the fact that though upon the earth's surface iron is rarely found uncombined, there are masses found in the basalt of Greenland which are altogether metallic and which in composition and structure closely resemble the meteoric irons. Though other views as to their origin have been advanced, many facts point to the conclusion that these iron masses have been brought up with the basalt and therefore indicate the existence of metal of this character in the deep interior of the earth. It has long been known that the matter constituting the interior of the earth must be more dense than that of the rocks which form its crust, since the specific gravity of the earth as a whole is 5.5, while that of the rocks of the crust is not more than 2.7. Professor Dana has shown

that if the interior were iron up to within 500 miles of the surface it would give to the earth its present density, and the outflow of iron at Greenland makes such a constitution seem very probable.

Since this material, too, so closely resembles the meteoric irons in constitution, and since basalts and peridotic rocks are found upon the earth which are analogous in constitution to many of the äerolites, it further seems probable, as pointed out by Daubrée, that the different meteorites represent in epitome the structure and constitution of the earth as a whole and that study of these is equivalent to penetrating by a side glance into the inaccessible depths of our own sphere.

Certainly, so far as present investigations have gone, a wonderful similarity in the constitution of the bodies of the universe is indicated, which may well lead to the belief that all knowledge gained regarding extra-terrestrial bodies but increases our sources of information concerning the history and structure of the earth itself.

BIBLIOGRAPHY.

For information in greater detail in regard to the subjects discussed in the foregoing pages, the reader will find the following works useful.

For lists of meteorites with localities and dates, see:

Catalogue of All Recorded Meteorites, with a Description of the Specimens in the Harvard College Collection. O. W. Huntington. Reprinted from Proc. Am. Acad. of Arts and Sci., 1887.

Die Meteoriten in Sammlungen, ihre Geschichte, mineralogische und chemische Beschaffenheit. Otto Buchner, Leipzig, 1863.

Die Meteoritensammlung des k. k. mineralogischen Hofkabinetes in Wien, am 1 Mai, 1885. Aristides Brezina, Vienna, 1885.

An Introduction to the Study of Meteorites, with a List of the Meteorites Represented in the Collection of the British Museum. L. Fletcher, London, 1890.

Guide dans la Collection de Météorites du Muséum d'Histoire Naturelle. Paris. Paris, 1889.

The Meteorite Collection in the U. S. National Museum. F. W. Clarke. From the Report of the Smithsonian Institution, 1885-86.

Catalogue of the Collection of Meteorites in the Peabody Museum of Yale College. E. S. Dana. American Journal of Science, Appendix to Vol. 32, 1886.

On the classification of meteorites, and the subject in general, see:

Beschreibung und Eintheiluug der Meteoriten, &c. G. Rose. Abhandlungen Ak., Berlin, Vol. 23, 1863.

Météorites. S. Meunier, Paris, 1884.

Lithological Studies. M. E. Wadsworth, Mem. Mus. Zool., Cambridge, 1884.

Die mikroskopische Beschaffenheit der Meteoriten. G. Tschermak, Stuttgart, 1883-85.

Meteoritenkunde. E. Cohen, Stuttgart, 1894.

On the chemical constitution of meteorites and their relations to terrestrial rocks, see:

Handbuch der Mineralchemie, pp. 901, 952. C. Rammelsberg, Berlin, 1860.

Die chemische Natur der Meteoriten. Same author. Abh. Ak., Berlin, 15, 1870 and 1, 1879.

Études Synthétiqnes de Géologie Expérimentale. A. Daubrée, Paris, 1879.

Cours de Géologie Comparée. S. Meunier, Paris, 1874.

Original Researches in Mineralogy and Chemistry by J. Lawrence Smith. Edited by J. B. Marvin, Louisville, Ky., 1884.

Article on "*Iron,*" *System of Mineralogy.* E. S. Dana, New York, 1893.

For the astronomical relations of meteorites, their spectra, origin, etc., see papers by J. Norman Lockyer in Nature 1888, vol. 37, pp. 55, 80; by H. A. Newton in Nature, 1879, vol. 19, p. 315, Proc. Am. Assoc. Adv. Sci. Vol. 35. 1886, Am. Jour. of Sci., Feb. and June 1886, and July 1888; and by R. S. Ball, Nature 1879, vol. 19, p. 493.

Descriptions of most American meteorites published soon after their fall or find are contained in the volumes of the American Journal of Science.

CATALOGUE OF THE COLLECTION.

EXPLANATORY.

The following abbreviations are used in this Catalogue.

W. f.,	Widmanstätten figures.
W.,	Purchased of Ward's Natural Science Establishment.
K.,	Purchased of Geo. F. Kunz.
*	Specimens available for exchange.
Cat. No.,	Numbers under this heading refer to those marked upon Museum labels.

CATALOGUE OF THE COLLECTION.

ÄEROSIDERITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams†
	Fell 1400? Recognized 1811.	**Elbogen,** Bohemia.	
1		Etched fragment showing W. f. (W.)	2.5
	Found 1780.	**Descubridora, Catorce,** San Luis Potosi, Mexico.	
2		Polished and etched slab. W. f. in long parallel. bands crossed at intervals by others nearly at right angles. (W.)	35
	Found 1784.	**Bembdego, Bahia,** Brazil.	
3		Scalings from crust, showing magnetite. (W.)	
4		*Irregular fragment, one surface polished.. Octahedral cleavage well exhibited. (W.)	32
5		Large slab showing natural and etched surfaces. The etched surface exhibits a coarsely crystalline structure with imperfect W. f.	1,132
6		Etched slab showing imperfect W. f., elongated nodules of troilite and a group of schreibersite inclusions. (W.)	855
	Found 1784.	**Xiquipilco, Toluca,** Mexico.	
7		*Complete individual. Form spheroidal. (W.)	464.5
8		*Complete individual. Irregular form. Octahedral cleavage well exhibited. (W.)	99.5
9		*Complete individual. Spheroidal form. Surface apparently water-worn. (W.)	263.5
10		Complete individual. Apparently water-worn surface. (W.)	251
11		*Complete individual. Spheroidal form. (W.)	227
12		Spheroidal individual with one etched face showing the typical, coarse W. f. and nodules of troilite. (W.)	816
13		Complete individual showing distinct octahedral cleavage. (W.)	112.5
14		*Polished slab. (W.)	225.5
15		Crescent shaped mass with surface 20x40 cm. etched. Shows coarse W. f. and nodules of troilite of various shapes and sizes. (W.)	16,665
16		Similar to above specimen but smaller. (W.)	6,166
17		Broken fragment showing well developed cleavage planes. (W.)	1,997
20		*Complete individual. (W.)	1,880
21		Complete individual, spheroidal. Surface very smooth. (W.)	1,107
22		Complete individual, hemispheroidal. Cleavage planes well marked. (W.)	28,038
23		Complete individual. Hemispheroidal. Shallow pits appear on the surface, (W.)	46,040

† 1 gram equals 15½ grains; 1000 grams equal 2.205 pounds.

AEROSIDERITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find	NAME AND DESCRIPTION.	Weight in grams.
	Found 1784.	**Xiquipilco, Toluca,** Mexico.	
24		Complete individual, spheroidal. Surface smooth and pitted. (W.)	18,025
25		Thin slab, etched. The W. f. are very distinct and regular. Nodules of troilite of various shapes are included. See Plate I, Fig. 1. (W.)	1,900
26		Like previous specimen, but W. f. less distinct. (W.)	2,423
27		Complete individual, crescentic in form. Shows strong tendency to scaling and decomposition. Drops of lawrencite appear on the surface. (W.)	19,954
370		*Section of flattened individual with etched surface. The latter shows coarse, well marked W. f. and several irregular nodules of troilite. Natural surface deeply pitted. (W.)	4,535
371		*Full-sized slab, etched. Shows the usual W. f. and coarse, vein-like masses of troilite. (W.)	792
372		*Complete individual showing pittings and natural surface. Form pyramidal. (W.)	2,506
	Found 1784.	**Ixtlhuaca, Toluca,** Mexico.	
18		Complete indiviaual. Surface pitted and covered with crust. (K.)	3.000
19		Scalings from previous specimen. (K.)	60
	Found 1792.	**Zacatecas,** Mexico.	
28		Thin fragment, etched. No W f. (W.)	5.7
	Found 1793.	**Cape of Good Hope,** Africa.	
29		Polished slab of brilliant nickel-white color. (W.)	27
	Found 1802.	**Albacher Mühle, Bitburg,** Rhenish Prussia.	
30		Polished slab Shows large pores and slag-like surface, due to its having been passed through a furnace. (W.)	70
31		*Fragment, three sides polished. The natural surface appears to be altering to limonite. (W.)	72
	Known 1804.	**Misteca, Oaxaca,** Mexico.	
32		Porous slab, etched. W. f. quite distinct. (W.)	86
	Known 1804.	**Charcas, San Luis Potosi,** Mexico.	
33		Thin slab, etched. Well marked W. f. (W.)	62
	Found 1808.	**Cross Timbers, Red River,** Texas.	
34		Chiseled fragment, one end etched. W. f. well brought out. (W.)	55
	Found 1814.	**Lenarto,** Saros, Hungary.	
35		Square slab showing crust on one side and one etched surface. No W. f. (W.)	47
	Found before 1819.	**Burlington, Otsego Co.,** New York.	
36		Triangular slab, etched on one surface. Very delicate W. f. (W.)	32

ÄEROSIDERITES OR IRON METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Known 1827.	**Sancha Estate, Santa Rosa, Coahuila,** Mexico.	
37		Thin, polished slab, a portion etched, but no W.f. brought out. (W.)	70
90		Turnings. (K.)	10
	Found 1832.	**Walker County,** Alabama.	
38		Thin, polished slab. The etched surface bears intersecting short straight lines similar to those regarded by Brezina in the Hex River Mountains iron, as plates of troilite. (W.)	25.5
39		Worked mass. (W.)	128
	Fell Aug. 1, 1835.	**Charlotte, Dickson Co.,** Tennessee.	
40		Thin slab, one surface etched. Typical W. f. (W.)	7
	Known 1836.	**Wichita County,** Texas.	
41		Full-sized slab, etched. Shows coarse W.f., nodules of troilite and scattered flakes of schreibersite. (W.)	1,396
	Found 1837.	**Butcher Irons, Desert of Mapimi, Coahuila,** Mexico.	
42		Large, thin slab, a portion etched. The latter shows a stippled surface intersected by numerous short, straight lines, probably of troilite, also nodules of same. (W.)	2,140
43		Large segment showing natural, polished and etched surfaces. Natural surface very smooth. Etched surface like that of previous specimen. (W.)	3,402
	Found 1839.	**Putnam County,** Georgia.	
44		Cleavage pieces showing octahedral form, separated by thin plates of taenite. (K.)	
	Found 1840.	**Magura, Arva,** Hungary.	
45		Etched slab showing delicate but very distinct W.f. The plates intersect at angles of 109°. (W.)	6
46		*Irregular fragment. Cleavage structure prominent. (W.)	137
47		Fragment showing natural and etched surface. No W. f. (W.)	166.5
	Described 1840.	**Cosby's Creek, Cocke Co.,** Tennessee.	
48		*Several irregular fragments, all showing octahedral cleavage. (W.)	40
49		Irregular fragment, cleavage structure prominent. The tin-white plates are taenite. (W.)	42.5
	Found 1840.	**Careyfort, De Kalb Co.,** Tennessee.	
50		Thin slab, one surface etched but showing no W. f. Troilite nodules and flakes of schreibersite appear on the etched portion. (W.)	55

ÄEROSIDERITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams
	Found 1840.	**Coney Fork, Carthage, Smith Co.,** Tennessee.	
51		Rectangular slab, polished. (W.)	50
52		Thick slab showing natural, polished and etched surfaces. Coarse W. f. are dimly outlined on the latter. The lines of taenite are very delicate. (W.)	78
	Found 1845.	**Sevier County,** Tennessee (Identical with Cocke Co.)	
53		*Five fragments of about 20 grams each, cleaving in octahedrons, which are separated by bright plates of taenite. (W.)	114
	Fell 1846.	**Deep Springs Farm, Rockingham Co.,** North Carolina.	
87		Thin slice showing sawed and etched surfaces. No W. f. (W.)	7
	Fell 1847.	**Braunau, Hauptmannsdorf,** Bohemia.	
55	July 14, 3:45 A. M.	Sawed block showing natural surface with pits. The lustre of the natural surface is like that of blued steel. (K.)	47
54		*Block showing polished and torn surface. (W.)	8.5
	Found 1847.	**Chesterville, Chester Co.,** South Carolina.	
56		Thin slab, etched. The etching brings out a network of irregular lines on the surface but shows no W. f. (W.)	6
	Found 1847.	**Seeläsgen,** Brandenburg, Prussia.	
57		Chiseled fragment. No cleavage structure visible. (W.)	41.5
375		Etched slab, containing large nodule of troilite. The iron is seen to be made up of large irregular plates but no W. f. appear. (W.)	12.5
	Found 1847.	**Murfreesboro, Rutherford Co.,** Tennessee.	
58		Etched slab showing distinct W. f., the plates of which run principally at right angles. (W.)	20.5
	Found 1850.	**Seneca Falls, Seneca River,** New York.	
60		Sawed section showing natural surface and fracture. Octahedral cleavage very distinct. One surface partially etched, bears an initial of the name of the first owner, Mr. L. C. Partridge. Loaned by G. Murray Guion.	300
	Known 1853.	**Lion River,** Great Namaqualand, South Africa.	
61		Sawed slab, one surface polished. (K.)	49.5
62		Etched slab, with crust. Beautiful W. f. are displayed, the plates being narrow and very distinct. See Plate III, Fig. 2. (W.)	62.5
376		*Like No. 62, but W. f. less distinct. (W.)	44
	Found 1853.	**Union County,** Georgia.	
63		Cleavage fragments with surface considerably oxidized. (W.)	1.5

ÄEROSIDERITES OR IRON METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1853.	**Knoxville, Tazewell Co.,** Tennessee.	
64		Slab showing natural and polished surface. (W.)	17
	Found 1854.	**Madoc, Hastings Co,,** Ontario, Canada.	
65		Spheroidal fragment showing natural surface with pittings. (W.)	9
66		Thin, sawed slab with natural surface. (K.)	5
	Found 1854.	**Emmitsburg, Frederick Co.,** Maryland.	
67		Etched slab with natural surface. W. f. well brought cut. (W.)	28.5
	Found 1854.	**Cranbourne,** Melbourne, Victoria, Australia.	
68		Irregular fragment much decomposed. A portion altered to limonite. Silvery plates of taenite are numerous through the mass. (W.)	31.2
69		Cleaved fragment, octahedral structure prominent. (W.)	4.5
	Found 1854.	**Yarra Yarra River,** Victoria, Australia. (Probably identical with **Cranbourne.**)	
70		Thin slab showing natural and etched surface. Crystalline structure is indicated on the etched surface, but no distinct W.f. are shown. (W.)	15
	Known 1856.	**Orange River,** Garib, South Africa..	
71		Sawed section with natural surface, smooth and deeply pitted. (K.)	114
72		Etched slab showing typical W. f. and nodule of troilite. (W.)	95 5
	Found 1856.	**Nelson County,** Kentucky.	
73		Apparently a large scaling slightly oxidized. (W.)	23
	Known 1856.	**Denton County,** Texas.	
74		Thin, sawed fragment. Along an old fracture are numerous parallel grooves which are probably lines of decomposition. (W.)	3
	Found 1857.	**Laurens County,** South Carolina.	
76		Thin slab, etched, showing beautiful W. f. The delicate bands, silvery white in color, and intersecting in equilateral triangles, stand out in sharp contrast to the dull gray of the ground mass. See Plate III, Fig 1. (W.)	13
	Found 1858.	**Staunton, Augusta Co.,** Virginia.	
78		Full-sized slab, polished and etched. Shows typical W. f. and large nodule of troilite (W.)	1,595
79		Slab with crust, etched. The crystalline plates have an ovoid form and intersect very irregularly. (W.)	665
80		*Slab with crust, polished and etched on two surfaces. Beautiful, broad and distinct W. f. (W.)	100.5

ÄEROSIDERITES OR IRON METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams
	Found 1858.	**Trenton, Washington Co.,** Wisconsin.	
81		Thin slab, etched, showing typical W. f., the plates of which intersect at angles of 35°. (W.)	137
82		*Specimen similar to foregoing, but smaller. (W.)	46
	Known 1860.	**Coopertown, Robertson Co.,** Tennessee.	
83		Thin slab, etched. The W. f. are made up of broad plates, 5mm. in thickness. (W.)	82.5
	Found 1860.	**Lagrange, Oldham Co.,** Kentucky.	
84		Sawed section with crust and etched surface. W. f. only slightly indicated. (W.)	47
	Recognized 1866.	**Smith's Mountain, Rockingham Co.,** North Carolina.	
85		Thin slab with crust, etched. Well marked W. f. Some of the bands are of oval shape. (W.)	17
86		*Similar to previous specimen. (W.)	13
	Found 1866.	**Bear Creek, Denver Co.,** Colorado.	
88		Fragment showing crust, Octahedral cleavage well displayed. (W.)	43.5
89		Thin slab, etched. Well marked W. f., the plates of taenite being very distinct. (W.)	27
	Found 1866.	**Juncal,** Paypote, Chile.	
140		Thin slab with crust, etched. Shows well marked W. f., the plates of taenite being very distinct. (W.)	60
	Found 1867.	**Allen County,** (near **Scottsville**) Kentucky.	
91		Full-sized slab, etched. Contains a circular nodule of troilite. The etched surface has the appearance of a network of delicate, straight lines overlaying a granular base. (W.)	364
	Found 1867,	**Auburn, Macon Co.,** Alabama.	
92		Sawed fragment showing crust on all surfaces but one. (W.)	5
	Found 1873.	**Chulafinnee, Cleburne Co.,** Alabama.	
94		Thin slab, etched. Broad W. f, are dimly outlined. (W.)	29
	Found 1874.	**Butler, Bates Co.,** Missouri.	
95		Etched slab. W. f very distinct. The plates of the latter seen with a lens appear to be made up of a number of smaller ones, which anastomose. There are also comb-like markings, made up of innumerable fine lines. (K.)	75.5
96		Same as previous specimen but containing nodule of troilite. (W.)	71.5
	Known 1875.	**Santa Catarina,** Rio San Francisco do Sul, Brazil.	
97		*Spheroidal mass, having the well known limonite yellow color of the Santa Catarina irons. More or less honey-combed by decay. (W.)	217

ÄEROSIDÈRITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find	NAME AND DESCRIPTION.	Weight in grams
	Known 1875.	**Santa Catarina,** Rio San Francisco do Sul, Brazil.	
99		Similar to previous specimen, except that one surface is polished, showing a compact, metallic interior. (W.)	921
100		Similar to No. 97. (W.)	2,579
103		Similar to No. 97. (W.)	4,252
98		Mass only slightly altered, of iron black color and metallic lustre. (K.)	261
101		*A number of fragments of various sizes, apparently altered to limonite, but, according to Derby, portions of a porphyritic crust. (K.)	1,814
102		*Similar to No. 97. (K.)	766
104		" " " (K.)	3,314
105		" " " (K.)	10,884
106		" " " (K.)	11,576
107		* " " " (K.)	3,174
108		* " " " (K.)	1,577
	Found 1876.	**Cleveland, Green Co.,** Tennessee.	
109		Polished slab, etched. No W. f. brought out by etching. (K.)	100
	Found 1877.	**Dalton, Whitfield Co.,** Georgia.	
110		Thin, etched slab showing coarse, typical W. f. and crust. (W.)	81
	Found 1880.	**Lexington County,** South Carolina.	
111		Thin slab, etched. Etching divides the surface into irregular grains, but no regular structure is visible. (W.)	23.5
	Found 1880.	**Ivanpah, San Bernardino Co.,** California.	
112		Chiseled fragment. No evidence of cleavage. (W.)	3
	Found 1882.	**Maverick County,** (Fort Duncan) Texas.	
113		Thin slab with reddish crust, etched. The etched surface has a stippled appearance, and shows a network of short, straight lines, probably representing plates of troilite. Small grains of troilite are also present. (W.)	104
	Found 1882.	**Jenny's Creek, Wayne Co.,** West Virginia.	
114		*Three chiseled fragments showing cleavage octahedrons, separated by bright plates of taenite. (K.)	16.5
	Found 1882.	**Hex River Mountains,** Cape Colony, So. Africa.	
115		Sawed slab, one surface etched. Neumann lines are partially discernible, but more prominent are the parallel systems of troilite plates described by Brezina. These are beautifully shown in this specimen. (W.)	448
	Found 1883.	**Grand Rapids,** Michigan.	
116		Full-sized slab, polished and etched. Shows very distinct and striking W. f made up of thin plates packed together in bundles. (W.)	1,160.5

AEROSIDERITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1883.	**Grand Rapids,** Michigan.	
117		Full-sized, thick section, polished and showing W. f. like previous specimen. (W.)	7,881
	Found 1884.	**Youndegin,** Western Australia.	
118		Full-sized, elongated slab, showing pittings, crust, polished and etched surface. The W. f. are very coarse, many of the plates being 1.5-2 cm. in thickness. They are also crossed by a series of finer lines nearly at right angles. Troilite and schreibersite are present. (W.)	1,087
119		*Polished fragment with crust. (W)	20.5
	Found 1884.	**Joe Wright Mountain, Independence Co.,** Arkansas.	
120		Thin slab, etched, showing nodules of troilite and typical W. f. The arrangement of plates about one of the troilite nodules suggests a spherulite. (W.)	98.5
121		Etched slab, showing markings like previous specimen except that the troilite occurs in interlocking veins. (K.)	33
	Found 1884.	**Glorieta Mountain, Santa Fe Co.,** New Mexico.	
122		Thin lab with crust, polished and etched. The well known W.f. of this iron are fully displayed. (W.)	1,271
123		Square slab, etched, showing both coarse and fine W. f. (K.)	152
	Found 1884.	**Hammond, St. Croix Co.,** Wisconsin.	
124		Thin slab, showing one etched and one polished surface. The W. f. have a peculiar, shagreened appearence, due to their grouping in smaller and larger squares and to scattered flakes of schreibersite. (W.)	35
125		Like previous specimen except that the W. f. are more distinct and the crust attains in some places a thickness of 1 mm. (W.)	20
	Found 1885.	**Puquios,** Chile.	
377		Full-sized slab, etched. Irregular W. f. are dimly brought out by the etching, also flakes of schreibersite. (W.)	154
	Found 1885.	**Stutsman County,** North Dakota.	
126		Thin fragment, one surface etched. W. f. are but dimly outlined. Many of the plates appear bent. (W.)	7
	Described 1885.	The **Lea Iron,** Tennessee.	
127		Large thin slab, showing crust, polished and etched surfaces. Typical W. f, (W.)	234
	Described 1886.	**Thunda,** Windorah, Queensland, Australia.	
128		Sawed slab, one surface etched. W. f. distinct and regular. (W.)	154

ÄEROSIDERITES OR IRON METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams
129	Found 1887.	**Chattooga County,** (Holland Store) Georgia. Thin fragment with crust. Polished surface. (W.)	28
130	Found 1887.	**Silver Crown, Laramie Co.,** Wyoming. Etched slab with crust. Structure coarsely crystalline, with a few rectilinear figures. Lines of taenite very distinct. (W.)	71
154	Found 1887.	**Floyd County,** (Indian Valley Township,) Virginia. Nearly complete individual, with natural surface. Crust yellowish-brown. Pittings broad and shallow. (K.)	13,142
378		Scalings from previous specimen, also highly polished fragment. (K.)	
131	Found 1888.	**Hamilton County,** Texas. Full-sized, thin slab, showing polished and etched surfaces. The W. f. appear as beautifully distinct and delicate lines running parallel in two directions throughout the mass. Troilite is distributed in radiating veins. See Plate I, Fig 2, and Plate II. (W.)	3,406
132	Found 1888.	**Welland,** Ontario, Canada. Segment, showing etched and natural surfaces. W. f. distinct and regular. Scattered grains of troilite are present. A marked tendency to octahedral cleavage is apparent. (W.)	715.5
133	Found 1889.	**Kenton County,** Kentucky. About one-third of the original mass, showing crust and polished surface. Contains nodules of troilite. (W.)	36,600
134		Full-sized slab, etched. W. f. very distinct and regular. Shows marked cleavage and tendency to separate along the cleavage planes. Very perfect octahedrons can be cleaved out from the mass. (W.)	9,312
135		*Full-sized slab. Both sides polished. (W.)	12,231
136	Found 1889.	**Henry County,** Virginia. Cleavage pieces, (octahedral) much oxidized. (K.)	79.5
137	Found 1890.	**Bridgewater, Burke Co.,** North Carolina. Thin slab with natural and etched surfaces. Exhibits well marked W. f. (W.)	19
138	Found 1890.	**Kendall County,** Texas. Thin slab with natural, sawed and etched surfaces. The etched surface exhibits a coarsely granular structure, crossed by a network of delicate, straight lines. Shows numerous nodules of troilite. (W.)	118
139	Found 1890.	**Nagy-Vazsony,** Hungary. Thin slab showing natural, etched and polished surfaces. Typical W. f. (W.)	37

ÄEROSIDERITES OR IRON METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Described 1890.	**Ellenboro, Rutherford Co.,** North Carolina.	
153		Spheroidal mass showing natural and etched surfaces and fracture. The latter shows the iron to be highly crystalline, and to possess octahedral cleavage. (W.)	1,506
	Found 1891.	**Cañon Diablo,** Arizona.	
141		*Three complete individuals apparently scaled off from a larger mass. All show the smooth surface and characteristic pits of this iron. (W.)	844
142		*Complete individual, ovoid in form. Crust and pits like No. 141. (W.)	552
143		Complete individual, weight, 1013 pounds. (See Pl. III, Fig. 3.) Besides the shallow pits shown in the figure the mass is indented by deeper cylindrical ones, three to four cm. in depth. (W.)	460,304
144		Full-sized slab with polished and etched surfaces. The W. f. are very coarse, arranged in approximately parallel bands. Large nodules of troilite and flakes of schreibersite are scattered through the mass. (W.)	2,934
145		*Small, complete individual, like No. 141. (W.)	165
146		Complete individual weighing 265 pounds. (See Pl. III, Fig. 3.) The chain by which it is suspended passes through a natural perforation about 3 cm. in its smallest diameter. (W.)	120,657
147		*Full-sized slab showing polished and etched surfaces like No. 144. (W.)	4,309
148		Nearly complete individual showing deep and shallow pits. One etched surface exhibits nodules of troilite and indications of crystalline structure. (W.)	23,590
149		Complete individual, sub-cylindrical in form. Exhibits the characteristic pittings. (K.)	90,898
150		Thick slab, polished, showing nodules of troilite. (K.)	26,047
151		Hemispheroidal mass. One polished surface shows troilite nodules. (K.)	24,489
152		*One large and several small fragments with natural surface. (K.)	1,814
373		*Complete individual showing pits and natural surface. Apparently scaled from a larger mass. (W.)	670
	Found 1893.	**El Capitan Mts.,** New Mexico.	
430		Slab showing crust and polished surface. (By exchange with E. E. HOWELL.)	214

ÄEROSIDEROLITES OR IRON-STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1749.	**Medwedewa, Krasnojarsk,** Siberia. (The Pallas Iron.)	
157		Fragment of the iron matrix with a little olivine. (W.)	9
158		Chiseled fragment showing both iron and olivine. (K.)	12.5
159		*Several fragments, composed of iron and olivine. (K.)	76.5
	Found about 1800.	**Imilac, Desert of Atacama,** South America.	
160		Fragment of iron matrix, most of the stony filling having decomposed and dropped out. (W.)	12.5
161		*Like previous specimen. (W.)	28.5
162		Thick slab, polished and etched. The metallic portion exhibits occasional W. f. Its sponge-like pores are filled with olivine, more or less decomposed. (W.)	205
	Found 1847.	**Rittersgrün,** Erzgebirge, Saxony.	
164		Thin slab, polished. The stony portion exceeds the metallic. (W.)	33.5
	Found 1856.	**Hainholz, Minden,** Westphalia.	
165		Thin chip, showing natural and polished surface. The metallic grains are small, and scattered through a brownish mass of asmanite and bronzite. (W.)	10.5
267		*Fragment from interior. Black, fine-grained. (W.)	1.3
75		*Like No. 165, but more decomposed. (K.)	19
	Found 1857.	**Miney, Taney Co.,** Missouri.	
166		Slab showing natural and polished surfaces. The natural surface has the peculiar glaze characteristic of this meteorite. (K.)	60
167		Sawed slab showing natural and polished surfaces. The metallic and non-metallic minerals are about equally abundant. (W.)	395
168		*Like previous specimen except that the olivine is gathered in large nodules in certain portions. (W.)	209
77		*Fragment with natural surface. (W.)	4
	Found 1861.	**Breitenbach,** Platten, Bohemia.	
169		Thin, polished slab. Resembles the Rittersgrün specimens very closely. (W.)	1
	Found 1862.	**Sierra de Chaco, Desert of Atacama,** South America.	
170		Fragment with crust. Structure fine-granular, with metallic and non-metallic minerals about equally distributed. (W.)	17.5
171		Similar to No. 170, except that the surface appears glazed and shines in iridescent colors. (W.)	14.5

ÄEROSIDEROLITES OR IRON-STONE METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1874.	**Mejillones,** near Desert of Atacama, South America.	
172		Thin, polished slab. The nickel-iron is distributed in a fine network and occasional nodules through an amorphous ground-mass. (W.)	37
	Fell 1879, May 10. 5 P. M.	**Estherville, Emmett County,** Iowa.	
175		Four complete individuals, varying in size from that of a pea to that of a walnut. The surface shows rounded knobs, and is partly of the color of blued steel and partly nickel-white. (K.)	70
176		Irregular fragment, much oxidized. (W.)	75
177		Full-sized slab, polished. The iron appears in large nodules, irregular flakes and a long, narrow vein, distributed through a greenish-black, structureless ground-mass. (W.)	2,721
178		*Thirteen complete individuals, varying in size from that of a pea to that of a walnut. Surface like No. 175. (W.)	47
	Found 1880.	**Carroll County,** (Eagle Station), Kentucky.	
180		Sawed slab showing natural surface deeply pitted, and polished surface. The iron matrix encloses nodules of olivine, some a centimeter in diameter, transparent, and of brilliant lustre. (K.)	106
182		Grains of olivine, separated from the iron, some coarse and some in a powdered state. (K.)	96
	Found 1885.	**Pavlodar,** Semipalatinsk, Asiatic Russia.	
183		Polished fragment, made up principally of olivine enclosed in an iron matrix. Also some loose grains of olivine. (W.)	15
	Found 1887.	**Rockwood, Cumberland Co.,** Tennessee.	
184		From Mass No. 1. Thin slab showing natural and etched surfaces. The metallic grains are small and about evenly distributed, except for three large nodules, one of which, having a diameter of 1.5 cm. shows well marked W. f. The metallic portion serves as a matrix to hold the siliceous grains. (W.)	40.5
185		Mass No. 2. Complete individual. The crust is reddish-brown and cracked in several places. No well-marked pits are seen. (W.)	4,351
186		From Mass No. 3. One-half of the original find, with natural and polished surface. General structure like No. 184, but the specimen shows a larger proportion of the non-metallic minerals, and these occur occasionally in large nodules. (W.)	801
187		From Mass No. 1 (?). Large segment showing natural and polished surfaces. Structure like No. 186. (W.)	6,151
374		*Segment of complete individual, showing natural and polished surfaces. Structure like No. 184. (W.)	670

ÄEROSIDEROLITES OR IRON-STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1887.	**Powder Mill Creek,** Crab Orchard Mts., Tennessee. (Identical with Rockwood.)	
336		Irregular fragment, one surface polished. Metallic grains small and evenly distributed. (K.)	80.4
	Found 1888.	**Llano del Inca,** Desert of Atacama, So. America.	
188		*Dark-brown mass, with natural and polished surfaces. Metallic grains appear only on one edge.	38
189		Complete individual, intersected by the cracks so characteristic of this meteorite. A few large grains of olivine are enclosed in cavities on the surface. (W.)	54.5
190		Thick slab, polished on two surfaces. No metallic grains are visible. (W.)	148
	Found 1888.	**Dona Inez,** Desert of Atacama, So. America.	
191		Thin slab, showing natural and etched surfaces. The stony matter, dark-brown in color, largely predominates. One nodule of iron about the size of a pea, shows delicate W. f. (W.)	48.5
192		*Hemispheroidal mass, one surface polished. The peculiar cracked surface characteristic of these meteorites is well exhibited. (W.)	103
193		Complete individual, described by Howell as looking like "a lump of dried, red mud cracked by shrinkage and covered with spots of green mould (nickel) in places." (W.)	741
194		Similar to No. 192, but larger. (W)	245
	Found 1890.	**Kiowa County,** (Brenham Township), Kansas.	
195		One-half of a complete individual one surface polished. Composed chiefly of iron, with olivine filling the sponge-like pores. (W.)	2,061
196		Thin slab, polished. The central portion for a width of about 5 cm. is solid metal, but on either side the mass is porous, the pores being filled with olivine. (W.)	1,248
197		Full-sized slab, polished, showing a sponge-like mass of iron, with olivine filling the cavities. See Plate IV, Fig. 1. (K.)	2,048
198		Similar to No. 197, but thicker. Some of the olivine nodules are beautifully transparent and highly refracting. (K.)	8,117
199		*Smaller piece, similar to No. 197. (K.)	227
200		466 pound mass, entire. The form is flattened, somewhat heart-shaped. The surface is covered with pittings, and considerably oxidized. The grains of olivine are readily discernible over the surface. See Plate IV, Fig. 2. (K.)	218,847
201		*Full-sized slab, showing structure like No. 197. (K.)	5,895
202		18 pound mass, entire. Form, hemispheroidal, the surface covered with pittings. Structure porous, pores filled with olivine. See Plate IV, Fig. 3. (K.)	8,619

ÄEROSIDEROLITES OR IRON-STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1890.	**Kiowa County,** (Brenham Township), Kansas.	
203		Section of complete individual, showing natural and polished surface. The structure is like that of No. 197. (K.)	8,490
204		345 pound mass, entire. This is almost wholly iron of the Caillite variety. Form, kidney or arch-shaped, with a projection extending from the concavity of the arch. See Plate IV, Fig.3.(K.)	155,473
205		36 pound mass, entire. Spheroidal in form, surface covered with pittings. Entirely metallic. See Plate IV, Fig. 3. (K.)	16,091
206		40 pound mass entire. Form, cylindrical, with one projecting point. Surface pitted. Composed almost wholly of iron, but occasional grains of olivine are visible. See Plate IV, Fig. 3. (K.)	17,687

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Fell 1492,	**Ensisheim,** Elsass, Germany.	
207	Nov. 16, 11:30 P. M.	Fragment from interior. Dark-gray, fine-grained, smooth and shining in portions. (W.)	22
208		Similar to previous specimen. (W.)	4
	Fell 1753.	**Krawin, Tabor,** Bohemia.	
209	July 3 8 P. M.	Fragment from interior. Light-gray with rusty iron spots. (W.)	.06
	Fell 1768,	**Mauerkirchen,** Austria.	
210	Nov. 20, 4 P. M.	Irregular fragment. Light-gray with black crust, 1 mm. in thickness. (W.)	17.5
211		Fragment with crust. Two polished surfaces show scattered metallic grains and well marked chondri. (K.)	110
212	Fell 1785, Feb. 19.	**Wittmess, Eichstädt,** Bavaria. Two fragments from interior, showing a gray, coarse ground-mass containing rusty iron grains. (W.)	1.7
	Fell 1790,	**Barbotan,** Landes, France.	
213	July 24, 9 P. M.	Fragment from interior, one surface polished, showing numerous, minute, metallic grains. (W.)	6
214		Fragment with crust, showing pitted surface. Much discolored by age. (K.)	32
	Fell 1795,	**Wold Cottage,** Thwing, Yorkshire, England.	
215	Dec. 13, 3:30 P. M.	Three polished chips, showing chondri and metallic grains, both coarse and fine. (W.)	2
	Fell 1789,	**Krakhut, Benares,** India.	
216	Dec. 13,	Powder, showing crust and individual chondri. (W.)	.71
217	8 P. M.	Fragment with crust. One surface polished, showing scattered metallic grains. (W.)	1
	Fell 1803,	**L'Aigle,** Normandie, Orne, France.	
218	April 26,	Gray powder. (W.)	.25
219	1 P. M.	Fragment with crust The latter thin, reddish brown, smooth. Interior grayish-brown, compact, porphyritic in appearance. (W.)	111
220		Fragment with crust and polished surface. The polished surface shows a few fine, metallic grains. Through a dark, amorphous ground-mass are mingled grayish-white nodules of various sizes. (K.)	60
	Fell 1806,	**Alais,** Gard, France.	
221	Mar. 15, 5 P. M.	Coarse, brown-black powder, resembling an earthy coal. Very friable. (W.)	1
222		Interior fragment like previous specimen. (K.)	0.4
	Fell 1807,	**Weston, Fairfield Co.,** Connecticut.	
224	Dec. 14, 6:30 A. M.	Fragment with crust. The latter, thin, dull-black. The yellowish and bluish-gray portions of the interior are distinctly separated. The chondri, of which the mass is largely made up, give it the appearance of a fine conglomerate. (W.)	9

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Fell 1808,	**Stannern, Iglau,** Moravia.	
225	May 22, 6 A. M.	Fragment from interior. Light-gray. Structure coarse-granular, not chondritic. (W.)	7.5
226		Fragment with crust; the latter glossy-black, veined. Interior greenish-black, brecciated. Shows one large grain of troilite. (W.)	23.5
227		*Fragment from interior, similar to No. 225. (W.)	1.5
	Fell 1810,	**Mooresfort, Tipperary,** Ireland.	
228	Aug., 12 M.	Fragment with crust. Crust black, somewhat shining. Interior, compact, ash-gray. Shows coarse, metallic grains and white chondri. (K)	7
	Fell 1810,	**Charsonville,** near Orleans, Loiret, France.	
229	Nov. 23, 1:30 P. M.	Fragment from interior. Light-gray, with rusty-brown spots, due to the oxidation of the abundant metallic grains. (W.)	22
230		Thin chip, polished. Like previous specimen, but traversed by a delicate, black vein. (W.)	2
	Fell 1812,	**Erxleben, Magdeburg,** Prussia.	
231	Apr. 15, 4 P. M.	Fragment from interior. Dark-gray, compact, made up of siliceous grains with a vitreous lustre, and numerous fine, metallic grains. (W.)	2.5
	Fell 1812,	**Chantonnay,** Vendée, France.	
232	Aug. 5, 2 A. M.	Thin chip, highly polished. Almost black, with few metallic grains. Structure not discernible megascopically. (W.)	2
	Fell 1813,	**Limerick, Adare,** Ireland.	
233	Sept. 10, 6 A. M.	Thin chip, polished. Dark-gray, with thickly distributed rusty iron flakes. (W.)	1.5
	Fell 1814,	**Alexejewka, Bachmut,** Ekaterinoslav, Russia.	
234	Sept. 15, Noon.	Fragment with crust and polished surface. Crust dull-black. Interior light-gray, with a few rusty grains. (W.)	12
	Fell 1814,	**Agen,** Lot-et-Garonne, France.	
235	Sept. 5, Noon.	Fragment from interior, showing white chondri and metallic grains distributed through a darker ground mass. (W.)	0.5
	Fell 1819,	**Politz.** near Gera, Reuss, Germany.	
236	Oct. 13, 8 A. M.	Fragment from interior. Dark gray, with metallic grains. (W.)	0.5
	Fell 1821,	**Juvinas,** Ardeche, France.	
237	June 15, 3:30 P. M.	Three fragments from interior. Dark-gray. Structure not well defined. No metallic grains visible. (W)	12
	Fell 1825,	**Nanjemoy,** Charles Co., Maryland.	
238	Feb. 10, 12 M.	Fragments from interior. Light-gray, fine-grained, somewhat friable. Metallic particles thickly distributed. (W.)	0.5

ÄEROLITES OR STONE METEORITES.

Cat No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
239	Fell 1828, June 4, 8:30 A. M.	**Richmond,** Henrico Co., Virginia. Fragment from interior. Composed chiefly of dark, angular, vitreous and coarse metallic grains. (W.)	2
240	Fell 1829, May 8, 3:30 P. M.	**Forsyth,** Monroe Co., Georgia. Thin chip, polished. Ground mass brownish-gray, containing chondri of lighter color, and scattered fine metallic grains. Also smaller fragments. (W.)	5
241		Fragment with crust. Crust black, dull and thick. Interior like previous specimen. (K.)	34
242	Fell 1831, July 18.	**Vouille,** Poitiers, Vienne, France. Fragment with crust. Interior, gray, compact, flecked with rusty iron grains. Several delicate, black veins, apparently filled with metal, traverse the specimen. Smaller fragments. (K.)	53
243		*Thin chip, polished. Well-marked chondri make up the larger part of the mass. Fine metallic grains are numerous. (W.)	3
354	Fell before 1838.	**Simbirsk,** Partsch, Russia. Micro-section. See Pl. VI, Fig. 1. (W.)	
245	Fell 1838, June 6, Noon.	**Chandakapur,** Beraar, India. Three fragments from interior, two of them polished, showing a dark-gray stone, containing numerous rusty iron grains. (W.)	3.5
246	Fell 1838, Oct. 13, 9 A. M.	**Cold Bokkeveld,** Cape of Good Hope, Africa. Fragment from interior. Dull-black, with white specks. Resembles a piece of graphite or bituminous coal. (W.)	1
249	Fell 1841, June 12, 1:30 P. M.	**Chateau Renard,** Loiret, France. Fragment from interior. Gray, compact, traversed by black, delicate veins. Metallic grains small and bright (W.)	57
248		*Like previous specimen. (W.)	7
247		*Like No. 249. (W.)	5
250	Fell 1842, Apr. 26, 3 P. M.	**Pusinsko Selo,** Milena, Croatia. Fragment from interior. Light-gray, with coarse and fine metallic grains. Shows distinct chondritic structure. (W.)	6
251	Fell 1843, March 25.	**Bishopville,** South Carolina. Fragment from interior. Light-gray, with white nodules of the chladnite of Shepard. Rusty brown spots show the presence of metallic grains. (W.)	1
252		Like previous specimen, but showing vitreous crust. (W.)	2
253		Fragments of chladnite. (K.)	5

ÄEROLITES OR STONE METEORITES.

Cat No	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
254	Fell 1846, Dec. 25, 2:45 P. M.	**Schönenberg, Swabia,** Bavaria. Fragment with crust. The latter is thick, somewhat shining and scoriaceous. The interior is dark-gray, shows metallic grains and light and dark chondri, and is traversed by narrow, branching veins of nickel-iron. (K.)	17
255	Fell 1847, Feb. 25, 2:45 P. M.	**Hartford, Linn Co.,** Iowa. Mass with crust. The crust, thick and dull black, is intersected by numerous cracks. Interior pearl-gray, abounding in minute iron grains. Delicate lines of fracture, which traverse the specimen, seem to mark slipping zones with slicken-sided surfaces. (W.)	128
256	Fell 1849, Oct. 31, 3 P. M.	**Monroe, Cabarras Co.,** North Carolina. Fragment from interior. Dark-gray, with white, rounded chondri and numerous metallic grains. Compact. (W.)	4
257	Fell 1850, June 13,	**Kesen,** Iwate Prefecture, Japan. Mass showing crust and interior. The crust surface differs little from the interior, except that the metallic grains of the former have been blackened by fusion, and broad, shallow pits appear on this surface. The interior is dark-gray, compact and plentifully sprinkled with rusty iron grains A portion of the surface is smoothed and grooved, indicating slipping along these planes. (W.)	1,286
258		Similar to previous specimen, but showing elongated pits on the crust surface. (W.)	1,211
259	Fell 1852, Jan. 23, 4:30 P. M.	**Yatoor, Nellore,** Madras, India. Fragments from interior. Gray, with dark chondri and rusty iron grains. (W.)	1
260	Fell 1852, Sept. 4, 4:30 P. M.	**Fekete, Mezo-Madaras,** Transylvania. Polished fragment from interior. In the dark-brown ground-mass are sharply outlined gray and white chondri, interspersed with bright, minute grains of nickel-iron. (W.)	2
261		Like previous specimen, but showing rough, dull-brown crust, not sharply separated from the interior. (W.)	4
262	Fell 1852, Oct. 13, 3 P. M.	**Borkut, Marmaros,** Hungary. Individual chondri, spheroidal, dark-green in color. (W.)	0.12
263	Fell 1853, Feb. 10, 1 P. M.	**Girgenti,** Sicily. Polished fragments from interior. Gray, very fine-grained, with bright, metallic grains. (W.)	1.1

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
264	Fell 1855, May 11, 3:30 P. M.	**Island of Oesel, Kaande,** Livland, Baltic Sea. Fragments with crust. Interior light-gray with rusty and bright metallic grains. Friable. Crust .5 mm. thick, dull-black, papillated. (W.)	2
265	Fell 1855, May 13, 5 P. M.	**Gnarrenburg, Bremervörde,** Hanover. Fragment from interior. Through a light, fine-grained ground-mass are scattered coarse particles of a greenish-black mineral. Few metallic grains. (W.)	0.5
268	Fell 1856, Nov. 12, 4 P. M.	**Trenzano,** Brescia, Italy. Cubical fragment, with crust on two surfaces. The latter shining, black, only slightly pitted, .3 mm. thick. Interior very compact, coarse grained, the metallic portion forming a network which encloses dark, spherical chondri, some of a diameter of 2 mm. (W.)	57
325		Smaller fragment, like previous specimen. (W.)	2
269		Like previous specimen. (W.)	26.5
270	Fell 1857, Feb. 28, Noon.	**Parnallee, Madras,** India. Fragment with crust. The latter is thin, brownish-black and differs little from the rest of the stone. The interior is coarse-grained, with few metallic grains. (W.)	3.5
271	Fell 1858, Dec. 9, 7:30 A. M.	**Ausson and Clarac,** Montrejeau, Haute Garonne, France. Fragment from interior. Light-gray, with rusty-iron grains. Compact. Delicate veins penetrate the mass. (W.)	13
272		Fragment from the interior, with polished surface. The latter shows large chondri of an olivine-like mineral, embedded in a ground mass made up chiefly of small white chondri and grains of nickel-iron. (K.)	22
273	Fell 1860, May, 1, 12:45 P. M.	**New Concord, Muskingum Co.,** Ohio. Nearly complete individual, of flattened, tetrahedral form, angles little rounded. A smooth, somewhat shining, black crust covers the slightly pitted surface. Interior dark-gray, compact and fine-grained. Metallic grains numerous. (W.)	347
274		Section from flattened individual, showing crust and two polished surfaces. The crust is thin, dull-black to reddish. A vein of metallic matter runs through the mass, and stands out in relief from the crust. The interior of the stone is dark-brown and gray. Metallic grains are large and abundant. (W.)	753

AEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find	NAME AND DESCRIPTION.	Weight in grams.
	Fell 1860,	**Dhurmsala,** Kangra, Punjaub, India.	
275	July 14,	Fragments from interior. (K.)	5
276	2·30 P. M.	Fragment with crust, the latter black, shining and showing numerous pits. Interior light-gray, with rusty grains. Compact. Nodules of a bluish gray, finer grained than the rest, are distributed through the mass. (W.)	123
	Fell 1861,	**Butsura,** Goruckpur, India.	
277	May 12.	Fragments with crust and polished surfaces. Iron is present in large amount, forming a matrix in which are held chondri 1 mm. in diameter, of an olivine-like mineral. The rest of the ground-mass is greenish-black, structureless. (W.)	1.85
	Fell 1861,	**Klein-Menow,** Alt-Strelitz, Mecklenberg.	
278	Oct. 7, 1:30 P. M.	Fragment from interior, made up of coarse, transparent grains with rusty metallic ones, the whole resembling a piece of brown sandstone. (W.)	2
	Fell 1863,	**Aukoma, Pillistifer,** Livland, Russia.	
279	Aug. 8, 12:30 P. M.	Fragment from interior. Dark-gray, compact. Made up of dark, transparent grains with a large number of minute specks of troilite. (W.)	1
	Found 1863-4	**Tomhannock Creek,** Rensselaer Co., New York.	
280		Fragment from interior, polished. Made up chiefly of metallic grains, and a dark-brown, olivine-like mineral. (W.)	1
281		Slice, showing crust. Interior portion like previous specimen. (W.)	7.5
	Fell 1864,	**Orgueil, Montauban,** Tarn et Garonne, France.	
282	May 14, 8 P.M.	Coarse, black powder, somewhat friable. (K.)	1.18
	Fell 1865,	**Aumale, Senhadja,** Algeria, Africa.	
283	Aug. 25, 11 A. M.	Slice from interior. Ash-gray, few metallic grains. Chondritic structure. (W.)	1.5
	Fell 1866,	**Knyahinya,** near Nagy-Berezna, Hungary.	
284	June 9, 5 P. M.	One-half of a complete individual, showing crust and polished surface. The latter exhibits large and small chondri, with few metallic grains. (W.)	82
285		Complete individual, covered with thin, black crust. (W.)	10
286		Complete individual, mostly covered with black, somewhat shining crust. Surface indented with shallow pits. (W.)	239
287		Flattened mass, showing crust and one polished surface. The crust surface is smooth and covered with small, conical pittings, giving to it the appearance of having a cellular structure. The polished surface well exhibits the aggregation of chondri which make up the mass of the stone. Some of the chondri reach a diameter of 3 mm. (K.)	3,231

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
288	Fell 1866, June 9, 5 P. M.	**Knyahinya,** near Nagy-Berezna, Hungary. Complete individual, of irregular, pyramidal form, surface covered with shining black crust. (K.)	82.5
289	Fell 1868, Jan. 30, 7 P. M.	**Pultusk,** Siedlce, Gostków, &c., Poland. Part of a large individual, showing crust and interior. The former dull-black, papillated; the latter, gray with rusty iron grains. All fine-grained. (W.)	350
290		*49 complete individuals, varying in size from a pea to a walnut. All covered more or less with crust, in some cases showing complete fusion of the surface, in others only a smoking of the same. (W.)	435.5
291		*Seven complete individuals of larger size than previous specimens, Covered with crust. (W.)	445
293		Fragment from interior. (K.)	1.9
294	Fell 1868, July 11.	**Ornans,** Doubs, France. Fragment, sawed from interior. Resembles a lump of hardened, sandy mud. (K.)	5
295	Fell 1868, Sept. 8, 2:30 A. M.	**Sauquis,** St. Etienne, Basses-Pyrénées, France. Fragment with crust and polished surface. Crust black and shining, about 1 mm. in thickness. Interior brownish-gray, with scattered metallic particles. Also fragment without crust, and micro-section. (K.)	12
296	Fell 1868, Dec. 5.	**Frankfort, Franklin Co.,** Alabama. Thin, sawed fragment. Light-gray with black and white grains. No metallic particles visible. (W.)	0.5
297	Fell 1869, Jan. 1, 12:30 P. M.	**Hessle,** near Upsala, Sweden. Sawed fragment, with thin, dull-black crust. Metallic grains coarse and numerous. (W.)	18
298		Fragment showing crust on all but two surfaces. (K.)	5
299	Fell 1869, May 22, 10 P. M.	**Kernouve, Cléguérec,** Morbihan, France. Fragment from interior. (W.)	0.4
300		Thin chip, one surface polished. Dark-gray, metallic and stony materials about equally distributed. (W.)	2
301		Thin, polished fragment. (W.)	24
302	Fell 1871, May 21, 8:15 A. M.	**Searsmont,** Waldo Co., Maine. Fragment from interior. Light-gray. (W.)	0.25
303		Various fragments from interior. Light-gray, with metallic grains of silvery lustre. Chondritic structure. (K.)	3
304	Fell 1871, Dec. 10, 1:30 P. M.	**Bandong,** Goemoroeh, Java. Two fragments from interior. Grayish-brown, with metallic particles. (W.)	1.5

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
	Found 1872.	**Waconda,** Mitchell Co., Kansas.	
309		*Mass from interior. Larger part light-gray in color, the remaining portion harder and darker. Large chondri are visible in the latter. (W.)	2,835
310		Fragment with crust. The latter thin, dull-black, blebby. A dark vein passes through a portion of the specimen. (W.)	151.5
311		*Fragment from interior, much weathered. (K.)	5.5
	Fell 1873,	**Jhung**, Punjaub, India.	
305	June.	Fragment from interior. Grayish-brown, coarse grained, chondritic, metallic particles few and small. (W.)	4
306		Thin, polished fragment, showing characters like previous specimen. (W.)	2.5
	Fell 1874,	**Nash Co.,** near **Castalia,** North Carolina.	
307	May 14, 2:30 P. M.	Fragment with crust; the latter dull-black and scoriaceous. The color of the stone is dark-gray, with no metallic grains visible. (W.)	1.5
308		Fragment from interior, showing occasional metallic grains. (W.)	6.5
	Fell 1875,	**Homestead, Iowa Co.,** Iowa.	
312	Feb. 12, 10:15 P. M.	Complete individual, nearly covered with crust. Surface indented with broad, shallow pits. Crust thin, dull-black. Interior of stone dark-gray. (W.)	3,175
313		*About three-fourths of a complete individual. Crust and interior like previous specimen. The chondritic structure is well exhibited, and metallic grains are numerous. (W.)	7,626
314		Polished slab with crust. The abundance of metallic constituents is well displayed in this specimen, as are also the chondri. (W.)	1,744
	Fell 1876,	**Ställdalen,** Orebro, Sweden.	
315	June 28, 11:30 A. M.	Fragment with crust. The latter black and shining. Interior of the stone dark-gray. (K.)	5
316		Irregular mass, with crust. Interior oxidized to a brownish-black mass, amid which it is difficult to distinguish the structural features. (K.)	50
	Fell 1877,	**Warrenton,** Warren Co., Missouri.	
317	Jan. 3.	Fragment from interior. Resembles a piece of hardened, sandy mud or blue clay, with a few metallic grains visible. (W.)	5
	Fell 1877,	**Sarbanovac, Soko-Banja,** N.-E. of Alexinatz, Servia.	
319	Oct. 13, 2 P. M.	Irregular fragment, of light-gray color, showing chondri about 2 mm. in diameter through the mass, also nodules of troilite and metallic grains. (W.)	33

ÄEROLITES OR STONE METEORITES.

Cat. No	Date of Fall or Find	NAME AND DESCRIPTION.	Weight in grams.
	Found 1878.	**Fayette,** Texas.	
173		About one-tenth the original mass, showing crust and polished surface. The crust surface is somewhat decomposed, but shows the characteristic pittings. The polished surface shows the dark-green color of the stone, with its fine texture and scattered metallic grains. (W.)	10,985
174		Thin slab from another portion of the specimen, exhibiting the black veins peculiar to this meteorite. (W.)	2,934
	Fell 1879. Aug. 1,	**Nagaya, Entre Rios,** Argentina, South America.	
320	Evening.	Small fragment, entirely black in color, one surface having a scoriaceous appearance, the remainder the lustre of graphite. (W.)	10
	Fell 1880. June 30.	**Carbonaceous Meteorite,** Province of **Entre Rios,** Argentina, South America.	
321.		Several fragments, having much the appearance of bits of black lava. (W.)	0.5
	Fell 1882,	**Mocs,** Kolos, Transylvania.	
322	Feb. 3, 4 P. M.	Nearly complete individual, cuboidal in form, with solid angles only slightly rounded. Interior grayish-brown in color, with coarse, metallic grains. (W.)	179
323		Elongated fragment, showing crust on two sides. Narrow, dark veins similar to those noted by Tschermak, pass through the mass in several directions. (W)	41
324		*Six fragments of nearly equal size, showing crust and interior. They have in general a cuboidal form with a prominence of the solid angles. Portions of the interior display a "slickensided" surface. (W.)	543
330		Complete individual, tetrahedral in form. Entirely covered with thick, black crust, except at one point, where the light-gray interior may be seen. (K.)	80.5
331		Complete individual, plano-convex in form, the convex surface being evidently the "breast" side. The opposite face shows a thinner crust and rougher surface. (K.)	6
	Fell 1883,	**Alfianello,** Brescia, Italy.	
332	Feb. 16, 3 P. M.	Fragment, with crust. The latter is about 0.4 mm. in thickness, and of a dirty black color. The interior of the stone is ash-gray, fine-grained, and contains metallic grains, with some coarse nodules of the same. (W.)	24
333		*Interior fragment, ash-gray, with brown spots, due to the oxidation of the metallic particles. Several of the latter are quite large, and rounded as if previously fused. (W.)	134.5

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find	NAME AND DESCRIPTION.	Weight in grams.
334	Fell 1883, Feb. 16, 3 P. M.	**Alfianello,** Brescia, Italy. *Large fragment, with crust. Characters like those of previous specimen. (K.)	300
335	Fell 1887, Aug. 30.	**Taborg,** Ochansk, Perm, Russia. Fragment with crust. The latter about 1 mm. thick, dull-black and blebby. Interior of stone light bluish-gray. Shows brecciated structure. Fine metallic grains are numerous. (W.)	23.5
337	Found 1888.	**Pipe Creek,** Texas. Irregular fragment, with one polished surface. A dark, heavy stone, with a large proportion of metallic grains. (K.)	100
338	Fell 1889, June 9.	**Mighei,** Southern Russia. Fragment, with crust. Of dark color, somewhat resembling a piece of graphite, and so friable as to soil the fingers. Crust reddish and scoriaceous. (W.)	1.5
339		Like previous specimen, except that crust is darker. Chondri of lighter color are distributed through the mass. (K.)	4.4
340	Fell 1890, May 2, 5:15 P. M.	**Leland, Winnebago Co.,** Iowa. 609 complete individuals, ranging in weight from one-tenth of an ounce to ten pounds each. They exhibit almost every variety of shape and degree of surface fusion. From the fully rounded specimens with thick, black crust there is every gradation to those whose rough surface is only slightly blackened, indicating that they separated from other masses only a short distance before reaching the earth. The interior, where seen, is light gray, with coarse, metallic particles. In the group is the stone which fell into a haystack without setting it on fire. (See Pl. V, Fig. 2.) (K.)	15.823
341		*57 complete individuals, all of small size. (W.)	354
326		Complete individual, with small, conical pittings resembling rain drop impressions. (W.)	282
342	Fell 1890, June 25, 1 P. M.	**Farmington, Washington Co.,** Kansas. Fragment from interior, having the appearance of a dolerite of dark-gray color and splintery fracture. Contains white, radiated chondri. Bronze-yellow metallic grains are numerous. (W.)	120
343		*Like previous specimen, but showing smooth crust which can be readily scaled off in certain spots. (W.)	560
344		Thin slab, polished, showing white and dark chondri, and various grains of nickeliferous iron. (W.)	425
345		*Similar to No. 343. (W.)	672
346		Full-sized slab, polished. Similar to above specimen. (W.)	3,302

ÄEROLITES OR STONE METEORITES.

Cat. No	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams
	Fell 1890, June 25, 1 P. M.	**Farmington, Washington Co.,** Kansas.	
347		Large section of complete individual, showing crust and one polished surface. The crust surface is rounded, but the usual pittings are absent. Bead-like projections mark the presence of metallic nodules which resisted fusion. (W.)	13,365
348		Full-sized slab, polished. The delicate veins filled with metal, noted by Preston, are beautifully exhibited in this specimen. (W.)	2,792
349		Nearly complete individual. The metallic beads on the surface are numerous, and the scale-like crust seems to be largely metallic. In other respects like previous specimen. (K.)	2,167
327		Section showing natural and polished surfaces. The latter shows several fissures filled with metal, running in two directions. (K.)	327
	Found 1891.	**Long Island, Phillips Co.,** Kansas.	
350		Nearly complete individual, made up of four pieces which have been placed together along the line of original fracture. The other 2,930 pieces, varying in weight from 10,000 grammes to 5 grammes, were probably also a part of the same individual at the time it fell to the earth. The surface of the main mass is indented by shallow, elliptical pits, the long axes of which run in parallel directions. The crust is smooth and brown, but in many places coated with a white incrustation of carbonate of lime, derived from the soil in which the stone lay. The interior of the mass shows a very compact, fine-grained texture, with few metallic grains; color, blue-gray. The smaller fragments are much rusted by exposure. (K.)	534,467
	Fell 1892, Aug. 29.	**Bath,** South Dakota.	
351		Irregular fragment, with crust and polished surface. The crust surface is indented with broad, shallow pits. Crust, dull-black, papillated, not more than .3 mm. in thickness. Interior, grayish-brown, of fine-granular structure, containing minute metallic grains. A portion shows "slickensided" surface. (W.)	1,276
	Fell 1893, May 26, 3 P. M.	**Beaver Creek,** British Columbia.	
352		Fragment, with crust. Interior, dark gray, made up of small, glassy chondri, and fine metallic grains. (W.)	5.5
353		Like previous specimen. Crust dull black, about .3 mm. thick. (W.)	19
		(DATE NOT KNOWN.)	
		Terni, Italy.	
356		Fragment, with crust. Crust dull-black, scoriaceous, nearly .2 mm. in thickness. Interior of stone light bluish-gray. Shows chondri and metallic grains. (W.)	2.5

ÄEROLITES OR STONE METEORITES.

Cat. No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
355		**Rockport.** Plano-convex mass, showing crust and polished surface. Crust reddish brown, about 1 mm. thick. Interior greenish-black, exhibiting no megascopic structure except scattered metallic grains and nodules. (W.)	72

CASTS OF METEORITES.

About 50 casts or models of meteorites are exhibited illustrating the size, form and superficial appearance of the original masses of which some of the specimens in the cases formed a part.

The following is a list:—

380—La Bella Roca, Mexico.
381—Wold Cottage, England.
382—Durala, India.
383—Babb's Mill, Tennesee.
384—Wichita County, Texas.
385—Nagy-Diwina, Hungary.
386—Akburpur, India.
387—Chesterville, S. C.
388—Braunau, Bohemia.
389—Nellore, India.
390—Segowlie, India.
391—Sarepta, Russia.
392—Verkhne Udinsk, Siberia.
393—Parnallee, India.
394—Staunton, Virginia.
395—Khiragurh, India.
396—New Concord, Ohio.
397—Breitenbach, Bohemia.
398—Butsura, India.
399—El Chanaralino, Chile.
400—Juncal, Chile.
401—Allan Co., Kentucky.
402—Goalpara, India.
403—Krähenberg, Bavaria.
404—Homestead, Iowa.
405—Middlesborough, England.
406—Hex River Mountains, S. Africa.
407—Joe Wright Mountain, Arkansas.
408—Glorieta Mountain, New Mexico.
409—Puquios, Chile.
410—East Tennesee.
411—Cabin Creek, Arkansas.
413—Rockwood No. 2. Tennesee.
414—Rockwood No. 3. Tennesee.
415—Hamilton Co., Texas.
416—Welland, Canada.
417—Kenton Co., Kentucky.
418—Kiowa Co., Kansas.
419—Washington Co., Kansas.
420—Cacaria, Durango, Mexico.
422—Chupaderos, Chihuahua, Mexico. 15,000 Kg.
423—Chupaderos, Chihuahua, Mexico. 9,000 Kg.
424—San Gregorio, Chihuahua, Mexico.
425—La Concepcion, Chihuahua, Mexico.
426—Descubridora, Catorze, Mexico.
427—Zacatecas, Mexico.
428—Teposcolula, Mexico.

INDEX TO METEORITES.

GENERAL INDEX.

PLATE I.

Fig. 1. Äerosiderite, Toluca, Mexico. Etched slab showing coarse Widmanstätten figures and elongated nodules of troilite. One-half natural size.

Fig. 2. Äerosiderite Hamilton Co., Texas. Etched slab showing delicate Widmanstätten figures and radiating inclusions of troilite. One-fourth natural size.

Fig. 1. Toluca, Mexico.

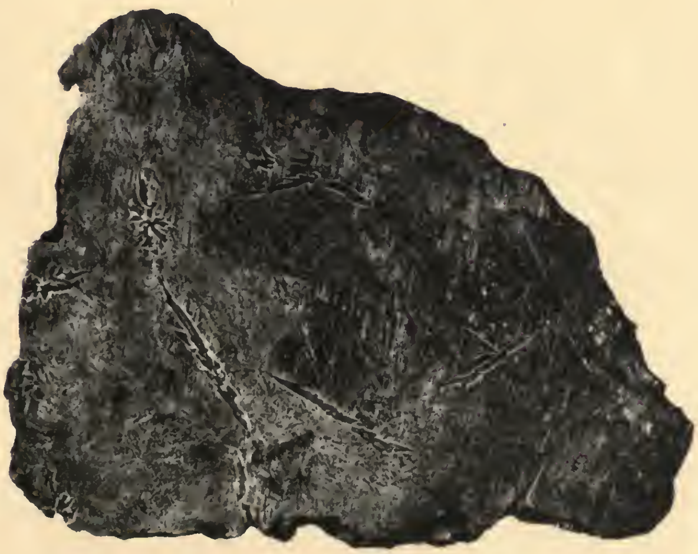


Fig. 2. Hamilton Co., Texas.

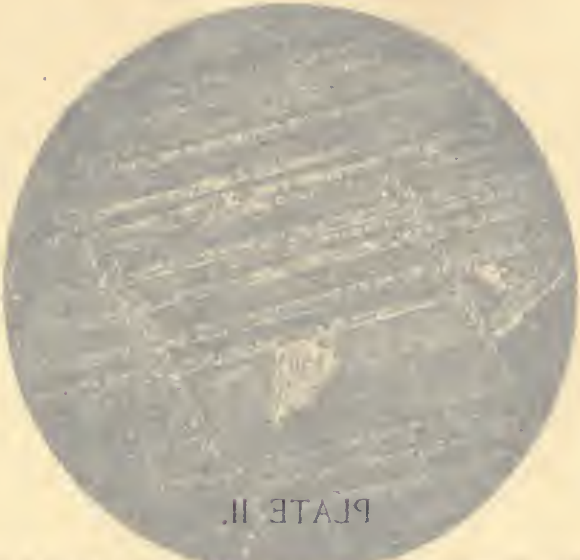


PLATE II.

Fig. 1. Portion of section shown in Plate I, Figure 2, magnified 14 diameters. The broad bands are the kamacite of Reichenbach and are bordered by narrow ones of taenite. The unindividualized ground-mass enclosed within the rhombs, is the so-called plessite, but this can be seen to pass imperceptibly into the slender parallel bands called, by J. Lawrence Smith, Laphamite markings.

Fig. 2. Another portion of the same section magnified 14 diameters. The etching figures are similar to those shown in Fig. 1, and there is also shown an inclusion of troilite, bordered by a layer of kamacite.

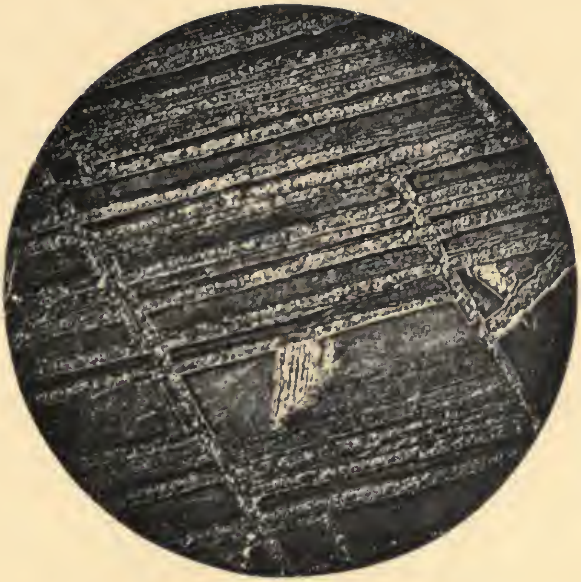


FIG. 1.

FIG. 2. Hamilton Co., Texas.

FIG. 1. Laurens Co., S. C.

FIG. 2. Lion River, S. Africa.

FIG. 3. Cañon Diablo, Arizona.

PLATE III.

Fig. 1. Äerosiderite, Laurens Co., South Carolina. Etched fragment showing characteristic Widmanstätten figures. Two-thirds natural size.

Fig. 2. Lion River, South Africa. Etched fragment showing characteristic Widmanstätten figures. Two-thirds natural size.

Fig. 3. Äerosiderites, Cañon Diablo, Arizona. The two masses weigh 265 and 1013 pounds respectively. The chain by which the smaller is supported, passes through a natural perforation.

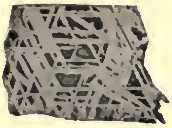


FIG. 1. Laurens Co., S. C.

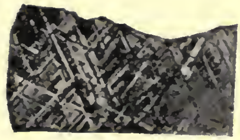


FIG. 2. Lion River, S. Africa.

FIG. 3. Cañon Diablo, Arizona.

Fig. 1

Fig. 2

Kiowa Co., Kansas.

Fig. 3. Kiowa Co., Kansas.

PLATE IV.

Äerosiderolites, Kiowa Co., Kansas.

Fig. 1. Section showing the sponge-like structure of these masses, the cavities of the metallic matrix being filled with chrysolite. One-fourth natural size.

Fig. 2. Single individual weighing 465 pounds. A Pallasite.

Fig. 3. Four individuals. The largest one, known, on account of its shape, as the "moon meteorite," weighs 344½ pounds. It is wholly metallic as is also the central mass below it. The other individuals contain a little chrysolite.

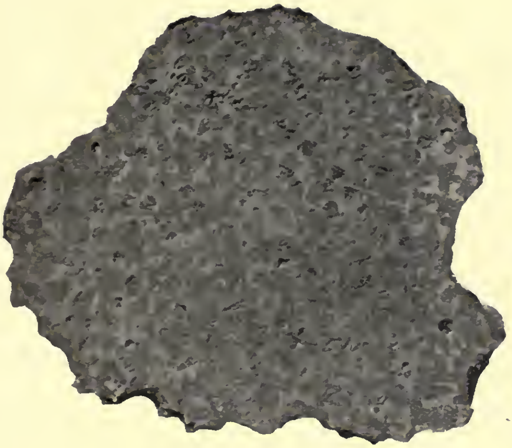


FIG. 1.

FIG. 2.

Kiowa Co., Kansas.

FIG. 3. Kiowa Co., Kansas.

Fig. 2. Leland, Winnebago Co., Iowa.

PLATE V.

Fig. 1. Äerolite, Long Island, Phillips Co., Kansas. This was probably a single mass, broken in pieces by striking on a ledge as it fell. Four of the largest of the fragments have been joined together along the planes of original fracture, giving the mass shown in the figure. The other fragments occupied the place of the pedestal. The white coating shown over a portion of the surface was undoubtedly formed subsequent to the fall of the stone. The true crust has the appearance of an earthenware glaze.

Fig. 2. Seven individual äerolites, Leland, Winnebago Co., Iowa, showing crust, pitted surface and interior.

FIG. 1. Long Island, Phillips Co., Kansas.

FIG. 2. Leland, Winnebago Co., Iowa.

PLATE VI.

Fig. 1. Micro-structure of äerolite from Simbirsk, Partsch, Russia. Magnified 13 diameters. The mass is made up of numerous chondri between 1 and 2 millimeters in diameter, which have a more or less circular outline and vary in structure from fibrous to coarse, granular. One chondrus made up of fibrous enstatite exhibits the peculiar, eccentric fan-shape which characterizes these chondri. The coarse grains are principally chrysolite.

Fig. 2. Single chondrus from the Clarac, Haute Garonne, France, äerolite, magnified 46 diameters. The mass of the chondrus is made up of lath-shaped individuals of pyroxene. It is enclosed in a shell of metallic grains which can be seen to give its border a distinct outline and separate it from the ground mass.

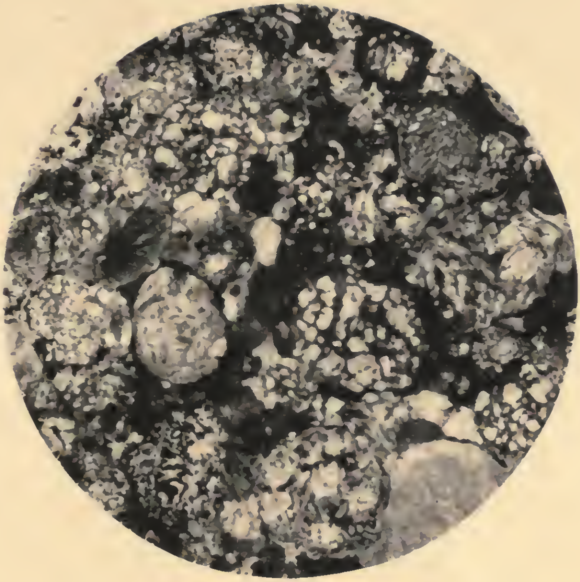


Fig. 1. Simbirsk, Partsch, Russia.

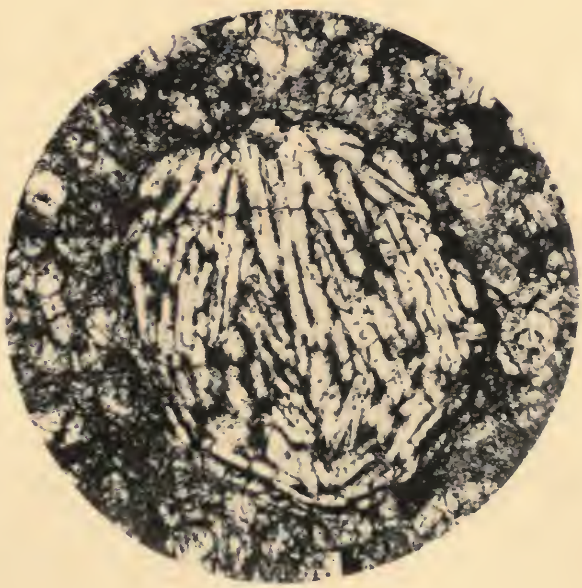


Fig. 2. Clarac, Haute Garonne, France.

PUBLICATIONS OF THE MUSEUM.

The series of publications of the Field Columbian Museum, of which this is a number, began with "An Historical and Descriptive Account of the Field Columbian Museum." Contributions to the series are not restricted in authorship or subject if coming within the scope of scientific or technical discussion and supporting the high standard it is hoped the publications will maintain.

The publications include transactions, memoirs, monographs, bulletins, handbooks, and catalogues of collections, and are numbered consecutively but are also sectional in character. Each series has a separate pagination and volumes: the literature of eachscience or general subject is in this way rendered consecutive and complete for binding.

The following publications have been issued:

Pub. 1. Hist. Series Vol. 1, No. 1. An Historical and Descriptive Account of the Field Columbian Museum.

Pub. 2. Hist. Series Vol. 1, No. 2, The Authentic Letters of Columbus.—William Eleroy Curtis, Honorary Curator of Columbus Memorial.

Pub. 3. Geol. Series Vol. 1 No. 1. Handbook and Catalogue of the Collection of Meteorites.—O. C. Farrington, Curator of Geology.

In preparation:

Anthropol. Series Vol. 1, No. 1. Pt. 1 Studies among the Ancient Cities of Mexico.—W. H. Holmes, Curator of Anthropology.

Anthropol. Series Vol. 1, No. 2. Pt. 2. Studies among the Ancient Cities of Mexico.—W. H. Holmes, Curator of Anthropology.

Bot. Series Vol. 1, No. 1. Flora of Yucatan.—C. F. Millspaugh, Curator of Botany.

Bot. Series Vol. 1, No. 2. Flora of West Virginia.—C. F. Millspaugh and L. W. Nuttall.

Zool. Series Vol. 1, No. 1. Vertebral Column of the Amia.—O. P. Hay, Assistant Curator of Ichthyology.